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Tube Milling

The tube mill, since its adoption from the cement industry, has naturally undergone changes to make it more suitable for grinding in cyaniding. The form of lining has been improved so that less time is required to put in a new lining and its life is greatly lengthened. The necessity of stopping the mill to add the pebbles has been overcome by the introduction of the spiral feed. Iron balls have given place to flint pebbles and the latter have in some instances been displaced by low-grade or barren mine rock.

In this connection it is interesting to note that some operators have found that in using mine rock as the crushing medium, it is preferable to give it a preliminary crushing treatment. By this means the sharp corners of the rock are broken off and disposed of before the ore is introduced into the mill, greater efficiency being claimed as a result of this "rounding off." Others tell us that while mine quartz is a good grinding agent it is not effective in protecting the ribbed lining used. It has been suggested that sufficient flint pebbles be used to provide the needed lining by becoming wedged between the ribs, leaving the quartz to do the grinding in the body of the tube. The economies of this scheme over using either all flint pebbles, which are expensive, or all quartz rock, are obvious.

Some phases of tube-mill operation have been investigated and conclusions reached, which admit of no argument, but many points remain concerning which there is much doubt. The advantage of classification to free the pulp from slime before tube milling is generally granted, but the percentage of moisture in the feed for greatest efficiency is still a mooted question. The Rand practice is generally given at about 38% moisture, but at least one operator advocates a percentage as low as 28 for certain conditions.

While it is probably impossible to find a set of rules for operation that will satisfy all conditions, systematic research should establish certain fundamental facts which will permit of more definite control of tube-mill operations. The field is a promising one and investigators should find ample reward for their labors in this direction.

Electric Power for Mines

The increasing use of electricity for power purposes has been a feature of the developments in mining practice during the last few years. It is especially true of the Lake Superior iron ranges, particularly of those in Michigan. Now that electric machinery has been developed to a point where the machines themselves are generally efficient and dependable, its installation is dependent to a large extent on the availability, at a reasonable cost, of the necessary current. In this, some districts are favored more by nature than others. Where electricity for power purposes is not for sale, the cost of installation may be prohibitive for a small, independent company; where water power is available within reasonable distance, the opportunity often presents itself for a power company to step into the breach, provided there are sufficient mines in surrounding districts.

Similar conditions make it possible for a large mining company, operating many mines within a comparatively small area, to develop power for a central plant which shall supply the individual mines. These are the conditions that exist on some of the Michigan iron ranges. The development in electric hoisting machinery, for instance, has, in many cases, made its use desirable. On one Michigan range the Cleveland-Cliffs Iron Co., operating a number of mines, has found it possible to develop from water power, in its own central plant, electric current to supply its mines. On another range,

not far distant, a power company has been formed to convert water power into electricity, which will be sold to small, independent mines.

While Porcupine was in its earliest development stage, work was rushed on two hydro-electric plants not far distant; the current from one of these is now being sold to a number of mining properties, some of which are merely prospects. Arrangements have been made to complete the other plant, and these two completed installations will afford competitive rates to the mines of the district, a condition to be desired. In other mining districts such companies have aided many independent mines in reducing power costs and have rendered exploratory work in out-of-the-way places less difficult. Either private or commercial, the central electric power plant for mining purposes is an established fact, and its future is a bright one.

As to Prospecting

We are unconsciously inclined to think of our country as one that has been pretty well prospected, one in which few important discoveries remain to be made. Yet a moment's thought will call to the mind of nearly every engineer certain unprospected corners in every Western state—places where perhaps he has had in mind making a quiet little investigation some day when he had a short respite from routine duties.

That there are plenty of unprospected spots still left in this country, and many others that have merely been "rushed" over, awaiting a calmer and more studied examination, is evidenced by the recent announcement by the U. S. Geological Survey of a potash discovery in California, by the calamine discoveries at Leadville, the salt domes of the Gulf region and the appreciation of the value of the sulphur deposits of the same section.

In telling of a recent visit to the Chilean nitrate fields, Prof. J. F. Newsom, at a recent meeting of the San Francisco section of the Mining and Metallurgical Society, stated that for the most part there were no surface indications of these valuable nitrate beds; one might walk over them for miles without recognizing the presence of anything valuable; the prospectors were compelled to put down holes and test the drillings. Yet these important deposits which do not have any marked surface features maintain an annual production valued at about $100,000,000 at the Chilean coast. On being asked whether he had seen any occurrences in this country that simulated the Chilean formation, Professor Newsom replied that he had not, but that he might have walked over any quantity, as any of us might, and never had a suspicion of its existence. Nitrates have been found in several places in this country, and it is possible that systematic prospecting would reveal commercial deposits.

The results of the Geological Survey's search for potash has indicated what may be revealed by systematic and intelligent prospecting. Many lands that have been gone over in the past may warrant re-prospecting for minerals, which changed market and transportation conditions have made valuable; witness, the deposits of the so called steel-hardening metals, such as the tungsten ores of Boulder County, Colorado, and the carnotite deposits of Colorado and Utah; even "porphyry coppers" might be mentioned as an example.

Something for Nothing

Opinions of Lake Superior mining men as to the practicability of applying efficiency engineering to underground mining differ considerably. At one of the copper mines where especial attention has been paid to the subject and considerable money spent in careful attention to details, the results are said to be very satisfactory; the management reports important reductions in cost, although a number of difficulties had to be first overcome, and by no means is the application of scientific management an easy matter to conditions that have existed through several generations of "good" miners.

At one of the iron mines where several months have been devoted to efficiency engineering, the results, while promising, will probably not be so successful as in the first case mentioned. It is contended that the problems in underground mining of variable formations do not permit of the standardization possible, say, in machine-shop practice. It is hoped to develop a detailed clerical system of recording the day's work of each man, so that the loafers can be weeded out, and a more intimate knowledge gained of the problems in each drift and stope. One of the chief difficulties encountered in trying to develop a good working system in the mines is the reluctance of some officials to increase the clerical or engineering forces to take care of the additional work. They are anxious to effect large savings by merely agreeing to adopt the system but without spending any money for a careful introduction of the principles to their particular mines.

In this respect a story is told of a furnace man from Buffalo who came into the Lake Superior country several years ago to purchase a "prospect or exploration." When several propositions had been submitted to him, and had been refused, he was asked what sort of an exploration he wanted. He replied that he wanted one showing a good body of high-grade ore of certain percentages of iron, phosphorus, sulphur, etc., which he named, and that it must be near the railroad, not too difficult to mine, besides several other qualifications; and for this he was willing to pay the price of an "exploration," say ten thousand dollars. The hard-working mining explorer who had been showing him around, bade him adieu at this point. "We haven't any pig-iron mines for sale today," said he.

The copper market this week became crazy on buying from Europe where some speculative operations seem to have come to a head. We are of the opinion that a slower and more orderly advance in the price for copper would have been better for the industry than what has been witnessed during the last month.

If the U. S. Geological Survey has been dilatory in some of its investigations and reports, it certainly is subjected to no such charge with respect to the alleged discovery of a billion tons of iron ore in Pennsylvania, which story it exploded inside of a week.

The practical settlement of the British coal strike after a full month of disturbance to industry is a gratifying event of this week. The American coal strike has not yet created any disturbance, its chief effect so far being only to afford a holiday to the men who have quit work.

The miners of Butte have showed their good sense by refusing to strike over a grievance that was of so little real consequence as to be scarcely a grievance at all.

By The Way

The inauguration of the 8-hr. shift for underground work in the Lake Superior iron mines will be a welcome change for the men, and probably a wise one for the operating companies. It will be interesting to observe next year its effects on per-ton costs.

Holders of Inspiration Copper who bought it on the theory that with so distinguished a directorate it would have to go up and could not go down, have now the assurance that though it has not gone up, it is a very good thing to hold for investment, says the *Evening Post*. Speculative purchases often turn into investments in that way.

An engineer sends us the following from a Utah paper: "The talk is that there is gold—a good deal of it—at Paria in Kane County, but there is mineral in the water used in mining it by the hydraulic method that prevents the quicksilver from getting action on the gold so as to extract it." It would be quite interesting, writes the engineer, to know what this mineral is that makes amalgamation difficult. We do not know. It may be "green" or "volatile" or "young." However, we do know that gold is capricious, obstinate and elusive, especially in its travel from the promoter's prospectus to the pockets of the stockholders. This fact has been discovered by that "small army of investors of whom," Horace J. Stevens quaintly remarks, "one is born every minute."

Arizona is a great, if young, state and in its copper production it has already outstripped many of its sister states. Leaving the domain of facts, however, we delve into the latest flotation literature that has come to hand. This relates to another "greater copper ledge on earth" found in Yavapai County by "a mining engineer and magazine writer" of Sycamore, Kan., who visited the property "to collect data concerning copper, and the discovery of the company's great ledge." From what the Kansas "expert" wrote we gather that he went out into the sycamore grove and lighted his pipe, whence arose a great smoke. Part of his dream is imparted to stockholders in the following verbiage: "Copper: a red, ductile tenaceous, maleable metal of great and varied use, originally called brass of cypress, copper sand, alacaunte, C group of minerals, mostly soft, included C cuprite, malaconite, malachite, malconite, chessylite, chrycopyrite, olivnite, etc. Black C ore, malaconite, gray C ore, Chalcocite, C Purite, yellow C ore, variety Chalcopyrite, the common ore. . . . The formation of the —— Copper Co. have blended with the iron, lime and porphyry with quartz. Many of the above minerals, but more especially the commoner forms with oxides condensed formation on the top with the iron and lime, with a great amount of carbon and sulphur in the schist formation, with an amalgamated condition of the various mineralizations where gold and silver predominates. The schist formation being soft it stands to reason that when the sulphides appear in the lower rocks, I am led to believe from the geological lay of the uplift that is now held and owned by the —— Copper Co. there is beneath the surface of this great iron-capped ledge a great body of copper ore." We are unable to follow the Kansas wizard into the New Mineralogy, but it must be impressive to the unsuspecting stockholders.

The old, "bred-in-the-bone" Cornishman of upper Michigan is a character that once met is not soon forgotten. While he has a distinct sense of humor, he is funniest when he least intends to be, and this is due in no small degree to his peculiar dialect, the latter being not only difficult to understand, but still more so to reproduce. The following is typical: The boss went up in a raise where two of his old reliable workmen were drilling, greeting them with, " 'Ow she coming up, boys?"—"Some slow, Cap'in, some slow." "Well," said he, "ne'er mind, patience and perce'verance will put un through." —And the Captain walked on. Said one of the men in the raise: "'Enry, wo be this Patience and this Perce'verance?" "Damned if I da knaw, lest be they taw bluddy Finlanders in tuther stowp."—Half an hour later found Henry and his partner demanding their pay up to date, just as the Captain stepped into the office. "Well, me sons, wha's matter?" "W'ur leavin', Cap'in; if yaw dha want they taw bluddy Finlanders to put un through, you cun 'ave 'ey; Patience and Perce'verance, 'ay? You cun 'ave 'ey, you cun 'ave 'ey."

For several years more or less secretive mining operations were conducted in the so called "crater," a unique natural feature near Cañon Diabolo, Ariz. Little has been said about these operations or their purpose. A correspondent now reports that they were in fact carried on with the idea of finding a diamond "pipe," similar to those characteristic of South Africa, and not for the purpose of yielding meteoric iron, as was originally stated. He states that "the operations at the crater were undertaken about two years ago by Philadelphia and Phœnix men, and were underway for some time. Drilling was tried but abandoned as impracticable, and later an effort was made to sink a shaft. This work proceeded to about 100 ft., and was stopped because of the great difficulty in controlling the dry, fluid, sand-like material in the crater, which had also baffled the attempts at drilling. At present no work is being done, and the results obtained did not give any encouragement. The report was that the crater, which has a cup-like depression with a distinct elevated rim in an otherwise undisturbed sedimentary region, was filled at the bottom with fine sandy angular material, probably an autoclastic silicious eruptive rock, with some pieces of lava-like rock near the surface. As far as explored, the whole crater filling is of this material. It runs almost like water in the shaft and operations in it were costly and difficult. The surface around the crater is strewn with meteoric fragments, as at Cañon Diabolo, not far away. This gave rise to the popular idea that the crater itself was formed by a gigantic meteorite which had buried itself deep in the earth, comminuting the rock and causing the 'rim,' as a marble would splash in mud. From this idea arose undoubtedly the original report that the explorations were undertaken in the hopes of finding a mass of meteoric iron; the value and availability for commercial purposes, if found, was a question. The operations, however, were conducted with ostentatious secrecy, and the operators now will not admit much as to the plans and work, but the diamond idea is believed to be correct. So far as reported, however, no diamonds have been found in the crater's filling, nor in its vicinity."

It is sometimes hard to understand the presence of the minority stockholder at a meeting where no information is divulged and no luncheon served, says the New York *Times*. He sits in the presence of half a dozen officials of his company, including the secretary, with his pile of proxies, and perhaps two or three other small holders who mistook their formal notification of the meeting to be in the nature of a call to duty. Not infrequently the small stockholder is bursting with advice on matters connected with his company, but he is never allowed to express his views. As for getting anything done, unless he has the backing of an insurgent movement, he might just as well have stayed at home. If he insists on offering a motion his few shares are buried under an avalanche of votes held by the secretary. Altogether, his lot would not seem to be a happy one. A persevering stockholder, who for years past has attended meetings where he was not wanted, explains that his time is not always wasted. "I usually ask some questions and am told that the books are unfortunately across the river or uptown," he said. "I make a motion or two and hear the chairman announce that I have lost by 256,000 to 50, or something like that. But my requests go on the record, and when the minority have to go into court to get what they think they are entitled to, we have evidence that information to which we were entitled was denied."

Copper Production and Consumption

Messrs. Aron Hirsch & Sohn, Halberstadt, Germany, publish the following estimate of the production and consumption of copper in 1911, the figures being in long tons:

	Production	Consumption
United States	437,300	316,791
Other No. America	80,150	3,000
South America	58,100	640,009
Europe	126,720	.....
Australia	44,600	20,000
Japan	55,000	.....
South Africa	7,000	.....
Other Africa, Asia, etc.	10,500	6,500
Total	869,370	986,300
Total, 1910	857,150	933,290

According to this estimate the world's consumption of copper exceeded the production by 76,140 tons in 1910, and by no less than 153,010 tons in 1911. The estimated stocks held at the close of 1910 were 143,777 tons, while at the end of 1911 they were 100,695 tons. The diminution of these visible stocks during 1910 was 23,684 tons; during 1911 it was 43,082 tons. In the figures of production and stocks no account is taken of scrap or old metal which enter into the consumption.

Chronology of Mining for March, 1912

Mar. 1—Dissolution of the Butte Coalition company was effected, the control of its property passing to the Anaconda company.

Mar. 2—President Taft issued a proclamation respecting the troubles in Mexico, advising American residents to keep out of them.

Mar. 4—The Supreme Court announced its decision to review the action of the Ninth U. S. Circuit Court of Appeals, which denied relief to the farmers of Deer Lodge Valley from the fumes of the smeltery at Anaconda, Montana.

Mar. 7—The Camp Bird mill, in Colorado, shut down temporarily because of danger of snowsildes.—Fire partially destroyed the Mogul cyanide plant in the Black Hills, South Dakota, entailing $75,000 damage, covered by insurance.—An explosion in the mine of the Diamond Vale Collieries Co., at Merritt, B. C., killed seven men.

Mar. 10—Fire partially destroyed the town of Kennett, California.

Mar. 11—The McIntyre 10-stamp mill, at Porcupine, commenced operation, becoming the first regular producer of bullion in the district.

Mar. 13—An underground fire did slight damage in No. 2 Kearsarge shaft of the Osceola Consolidated Mining Co., in Michigan.

Mar. 14—A snowslide killed four men at the Black Bear mine, in the San Juan region, Colorado.

Mar. 15—Water was turned into the hydro-electric plant of the Homestake Mining Co., in South Dakota.—The Arizona Commercial Copper Co. went into the hands of a receiver, in default of interest on a $1,000,000 bond issue.

Mar. 16—An explosion was reported to have killed 45 men in the Italianka coal mine, in Russia.

Mar. 18—The smeltery of the American Smelting & Refining Co., at Durango, Colo., was blown in after a shutdown since November.

Mar. 20—An explosion in the Chant No. 2 mine of the Sans Bois Coal Co., at McCurtain, Okla., killed 74 men.

Mar. 26—An explosion at the Jed Coal & Coke Co.'s Jed mine, two miles from Welch, W. Va., reported to have killed 81 men.

Mar. 30—Slides are reported to have started at Turtle Mountain, near Frank, Alberta.

March Dividends

The accompanying table shows the dividends of the American mining, metallurgical and coal companies, paid during March, 1912. The dividends reported amount to $17,388,642, as contrasted with the $29,844,356 shown in the JOURNAL for March, 1911. This tremendous falling off is not real, being due to $14,500,000 being shown last year as the Standard Oil disbursement for March, to which we have nothing this year to correspond.

Standard Oil was interesting because of its bigness. The subsidiaries we have dropped from the list for several reasons. It is hard to tell where oil producing ends and transportation and manufacturing begin. Many independents are as large as the subsidiaries, but do not wish to report earnings and dividends, while the California oil region is so important that a separate table later in the month seems necessary.

On the side of straight metal mining in the United States, the figures are distinctly encouraging, this year's figures being $4,983,399, against last year's $4,878,308, while Canada and Mexico this year pay $1,354,100, as against last year's $603,808. It is unfortunate, of course, that such figures can only be comparative, and not absolute. Thus, there is, in the payments by the Superior & Pittsburg and Calumet & Arizona, a certain amount of duplication, while the disbursements of Cananea Central and Greene Consolidated, are the basis for the payments by Greene Cananea among the holding companies. However, after making all allowances for duplication, the figures are a decided tribute to the solidity of the American mining industry.

Calumet & Hecla increased its dividend from $6 to $8 per share, a return of about 6.75% on the present price of the stock. Champion was another Michigan company to delight its shareholders, declaring two $1 dividends in March, a total of $4 per share in the first three months of the year. Quincy also paid, but simply at its usual rate of $1 quarterly.

In Utah, Opohongo paid its second dividend. Utah Copper continued at the rate of $0.75 quarterly, disappointing those who had been prophesying and buying for an increase, as well as those who are continually crying "bad management."

Federal Lead was forced to cut its preferred dividend to 1½% quarterly, while Yukon Gold continues paying at the reduced rate instituted in December.

Greene Consolidated, after an absence of four years from the list, "came back" with a payment of $600,000. Cananea Central also paid $360,000, so that Greene-Cananea, the holding corporation, was able to return $618,828 to its stockholders, the remainder going largely to cover previous administration expenses. New York & Honduras Rosario also paid in this month, after a year of silence.

The Temiskaming Mining Co. paid its first dividend since the purchase of the North Dome mine, which it is now considering selling.

United States Mining Companies	Situation	Per Share	Total
Bingham-New Haven, c.	Utah	$0.10	$22,869
Bunker Hill Con., g.	Calif.	0.07½	15,000
Bunker Hill & Sull., l.s.	Ida.	0.15	49,050
Calumet & Ariz., c.	Ariz.	1.00	596,353
Calumet & Hecla, c.	Mich.	8.00	800,000
Champion, c.	Mich.	2.00	200,000
Colorado, l.s.g.	Utah	0.03	30,000
Doe Run, l.	Miss.	1.50	98,675
El Paso, g.	Colo.	0.01	24,500
Federal M. & S. l., pfd.	Ida.	1.50	180,000
Frontier, z.	Wis.	2.00	2,500
Hecla, l.s.	Ida.	0.02	20,000
Nevada Con., c.	Nev.	0.37½	749,389
North Star, g.	Calif.	0.10	25,000
Opohongo, g.s.l.	Utah	0.01	8,990
Quincy, c.	Mich.	1.00	110,000
St. Joseph, l.	Mo.	0.15	150,000
Success, z.	Ida.	0.01	15,000
Superior & Pittsburg, c.	Ariz.	0.30	449,938
United Verde, c.	Ariz.	0.75	225,000
Utah Copper, c.	Utah	0.75	1,173,635
Yukon Gold, g.	Alas.	0.07½	262,500
Coal, Iron, Industrial and Holding Companies	**Situation**	**Per Share**	**Total**
American Coal.	Penn.	$0.75	$37,500
Am. Sm. & Ref., com.	U. S.	0.66⅔	333,333
Am. Sm. & Ref., pfd.	Mex.	0.16⅔	583,338
Crucible Steel Co.	U. S.	1.75	427,630
General Asphalt, pfd.	U. S.	1.25	164,129
General Chem., com.	U. S.	1.50	122,268
Greene-Cananea, c.	U. S.	0.25	618,820
Harbison-Walker, com.	U. S.	0.50	90,002
Inter. Nickel, com.	U. S.	5.00	579,130
Inter. Sm. & Ref.	U. S.	2.00	200,003
National Lead, pfd.	U. S.	1.75	426,433
National Lead, com.	U. S.	0.75	154,914
Phelps, Dodge & Co.	U. S.	2.50	1,125,000
Texas & Pacific Coal.	Tex.	1.50	37,500
U. S. Steel, com.	U. S.	1.25	6,353,781
Canadian, Mexican and Central American Companies	**Situation**	**Per Share**	**Total**
Cananea Central, c.	Son.	$0.60	$360,000
Crown Reserve, s.	Ont.	0.05	88,441
Greene Consol., c.	Son.	0.60	600,000
Hedley, g.	B. C.	0.50	60,000
Kerr Lake, s.	Ont.	0.25	150,000
Lucky Tiger, g.	Mex.	0.05	35,767
N.Y. & Hon. Rosario, g.	C. A.	0.15	22,500
Rio Plata, s.	Mex.	0.10	37,392

Correspondence and Discussion

Views, Suggestions and Experiences of Readers

Grinding Analyses and Their Application

In regard to H. Stadler's work on grinding analyses, I am at a loss to understand how he arrives at the relation between energy units, and mesh aperture.

J. C. F.

New York, March 24, 1912.

[In Mr. Stadler's original paper[1] on the subject this phase was covered and the following explanation is taken from this source.

The area of fracture, over which the cohesion of the molecules has to be destroyed, multiplied by a coefficient determining the resistance which the molecules oppose to their separation by the exercise of stress (crushing, tensile, shearing, etc.), represents the *force* required to cause the fracture. To perform mechanical work this force must run through a *distance*, represented by the deformation which the body can stand before reaching the breaking point.

It is immaterial that the distance of deformation varies in a heterogeneous body and since relative values only are desired even the exact extent of deformation is unnecessary. It is only essential to make sure that this factor is a constant function of the diameter of the particles to be crushed.

Mechanical work is the product of a force times the distance through which it moves, but as in the regular scale of reduction by volume, the diameters of the particles decrease at the same ratio as the area of fracture increases, the mechanical work required for reducing the volume (or weight) of the unit from one grade to the next following is a constant for each grade, called the crushing or energy unit (E. U.). The same conclusion is reached by Kick's law: "The energy required for producing analogous changes of configuration of geometrically similar bodies of equal technological state varies as the volumes or weights of these bodies."

The volumes of the particles decrease from grade to grade at the same ratio as the number of particles—constituting in their total the value of the unit—increases and the product of the volumes into the number of particles of that grade is therefore a constant for each grade. As in conformity to the above law the amount of energy absorbed is proportional to the volume of the body to be crushed, it follows also that the total energy required for reducing the weight of the unit is constant for each grade.

The ordinal numbers of any arithmetical progression given to these grades represent consequently the relative values of the energy which must be spent upon producing these respective grades from the initial unit and the mechanical value of the grade. For obtaining the mechanical value of mixed sands it is only necessary to multiply the percentages of the grades by the number of the energy units of the respective grade and add the products.

To illustrate this method of calculating the mechanical efficiency of a given crushing machine, the example in the accompanying table is given, the following data also being used: Tube mill dimensions, 22 ft. by 5 ft. 6 in.; speed, 30 r.p.m.; power consumed, say 100 hp.; banket-ore feed, 6.75 tons per 24 hr.;

STADLER'S METHOD OF COMPUTING TUBE MILL EFFICIENCY

	E.U.	Feed Analysis, Per Cent.	Feed Total E.U.	Discharge Analysis, Per Cent.	Discharge Total E.U.
+12	13	27.6	3.59	....	.....
+20	15	15.7	2.36	....	.....
+30	17	13.7	2.33	7.4	1.26
+50	19	19.9	3.78	22.5	4.28
+80	21	15.5	3.26	29.0	6.09
+120	23	2.0	0.46	6.0	1.38
+200	25	1.6	0.40	7.7	1.93
—200	28	4.0	1.12	27.4	7.67
Total..	..	....	17.30	....	22.61

duty, 290 tons per 24 hr. In the first column the grades given are those of the Mines Trial Committee; in the second column the mechanical value of the mean grade in energy units.

By reference to the table it will be seen that the total mechanical value of the discharge is 22.61 E. U. from which must be deducted 17.30 E. U., the mechanical value of intake, thereby obtaining 5.31 E.U. as the work done per unit (say 1 ton). The work done by the tube mill in 24 hr. is obtained as follows: Reduction of pulp feed, 1539.9 E.U. (290x 5.31); reduction of banket ore, 202.5 (6.75x30); total, 1742.4 E.U. Assuming that the power consumption was 100 hp., the relative mechanical efficiency is 17.42 per horsepower.

The following statement is also necessary for a full understanding of the above calculations: The energy absorbed in the reduction of banket-ore feed to the size of the final pulp as an average is estimated at 30 E.U. (26 E.U. being the mechanical value of the final pulp with reference to the initial unit, plus 4 E.U. representing the energy absorbed in the reduction of 4-in. pieces to the size of the initial unit or zero-grade.—Editor.]

[1]Trans. I. M. M., Vol. XIX, 1909-1910.

Where Should the Primer Go?

With regard to the position of the primer, Mr. Semple's experiment, cited in the Journal of Mar. 23, 1912, igniting a fuse "threaded through a series of dynamite cartridges," is not conclusive, because holes are never loaded in that way. The capped fuse is inserted in one stick to make the primer, and the fuse lies alongside, and outside of those sticks which are inserted in the hole after the primer, the paper wrapping of those sticks intervening between the fuse and the dynamite. This paper wrapping burns freely in the open air, but with difficulty in a tightly tamped hole. The custom of placing the primer near the bottom of the hole is practically universal among those miners engaged in machine drilling,

In one case of tunnel work (Gunnison tunnel, December, 1909), by an unusual combination of circumstances governing ventilation, I was enabled to witness from a safe distance the actual explosion of a series of rounds of holes, continuing through several weeks. The holes were uppers, 4 to 6 ft. deep, loaded with 8 to 12 sticks of 60% gelatin dynamite, 1⅛ in. diameter, and were fired in rounds of 50 to 60 holes. The loading and firing were carefully superintended by the shift boss, himself an experienced miner, and the primer was invariably inserted as the second or third stick in each hole. After spitting and during the period of explosion, the smoke was continually carried away by a strong air current, and it was easy to distinguish between the sudden flash of a detonated hole and the steady, long continued flare of a burning hole. Of some 600 holes, whose explosion I personally witnessed under these circumstances, only two burnt.

Mr. Semple criticizes my stipulation of a load of nine sticks in a hole in a 5-ft. round. I mentioned that quantity as covering the extreme of my own experience. The conditions which, in some few cases, have justified me in putting that much dynamite in one hole, while interesting in themselves, are not germane to this discussion.

Harvey S. Brown.

Victor, Colo., Mar. 26, 1912.

Calumet & Arizona Smeltery

Much of the concrete work has been completed and a number of important contracts have been placed for equipment for the new smeltery that is being built at Douglas, Ariz., for the Calumet & Arizona Mining Co. Repath & McGregor, engineers, are designing the plant and supervising the construction.

The following is a brief description of the plant being constructed. It is proposed to equip the present ore-receiving bins with chutes suitable for feeding the ore into the hoppers of conveyor feeders. The ore bins will be equipped on both sides with a 30-in. conveyor which will convey the ore directly to the sampling and crushing plant. For the coke-receiving bins it is proposed to utilize the present storage trestle as an approach, and for the coke bins proper a new steel structure will be built.

Crushing and Sampling Plant

The crushing and sampling plant proposed is estimated to have a capacity of 100 tons per hour if all the material passing through it is crushed down fine for roasting, or it will have a capacity of approximately 200 tons per hour if the large pieces of ore are screened out for blast furnaces. The building is to be of steel and concrete throughout, and is to be 40x84 ft. five stories high. The mill is to be divided into sections, which may be run independently of one another. Each section will have a crushing and sampling department. In the sampling department the ore will be cut four times by Snyder or similar automatic samplers, so that for each ton of ore, a sample weighing 1.6 or 3.2 lb. as desired, may be obtained. All the ore from the bins will pass through the crushing or sampling plant. The plant will be flexible, and suitable arrangement will be made for sending the ore directly to the bins without sampling or crushing. The plant will be so arranged that sulphides may be crushed down to ⅜ in. for the roasters, or they may be screened and the coarse lumps sent directly to the blast-furnace beds.

Bedding and Conveyor System

From the sampling and crushing plant the materials will pass directly to either the coarse-ore beds or to the fine-ore beds by belt conveyors. The bedding scheme proposed will practically duplicate the Cananea system. Three beds for coarse ore will be provided, each having a capacity of 10,000 tons. Three beds will be provided for the fines, each having a capacity of 10,000 tons, and a bed will be provided for the coke which will have a capacity of 3500 tons. The coke will be dumped from the cars into the coke-receiving bins and from the bins it will be conveyed directly to the blast-furnace charge bins or to the coke-storage bed. The coarse and fine ore will be reclaimed as it is done at Cananea. The coke from the storage bed will be reclaimed by shoveling or wheeling it to a conveyor-belt feeder. The coarse ore and coke will be conveyed up an incline to the ore and coke charge bins directly over the blast-furnace charge floor. The fine ore will be conveyed up a similar incline to the roasting plant.

Roasting Plant

The roasting plant will contain twelve 21x6-ft. diameter Herreshoff roasters, each having a capacity of approximately 75 tons fine ore per day. The roasting plant will be equipped with a brick dust chamber of ample capacity for settling the fine dust carried with the fumes. For this dust chamber and also the blast-furnace dust chamber copper roofing will be used.

The main smeltery building will be 168x506 ft. in plan and in it will be two blast furnaces, four reverberatory furnaces, six converters, and the converter slag- and copper-casting department. The blast and reverberatory furnaces will be on one side of the main aisle, while the converters and casting machines will be on the other.

Blast Furnace Department

Two 48-in. by 40-ft. blast furnaces will be installed. Ore and coke will be discharged directly from the bins just over the charge floor into the charge cars, which will be resting upon the platform scales, so that the amount of coke and ore for each charge will be accurately determined. The charge car will be moved from the scales to the charge doors of the furnace by a small electric motor geared to it. A large steel dust chamber 60x140 x70 ft. high will be provided which will have ample capacity to settle the blast-furnace dust and converter dust. It is proposed to pass the converter gases through this chamber.

Reverberatory Department

In the reverberatory department four reverberatories will be installed, having hearths 19x100 ft. leaving a foundation space for a fifth furnace. Each of the furnaces will be equipped with two waste-heat boilers of 712 hp. capacity each. The furnaces will be charged directly from calcine cars running on tracks overhead. Matte will be tapped into large ladles and conveyed by cranes to the converters. The slag will be skimmed directly into large slag pots running on tracks underneath, and just in front of the furnaces.

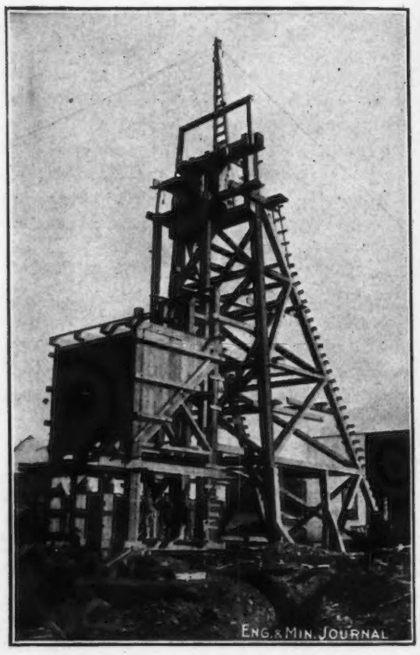
The main converter aisle will be 55 ft. wide and will be equipped with two 40-ton electric traveling cranes. Six vertical Great Falls type converters will be installed. Two straight-line casting machines will be installed. It is proposed to erect a steel chimney which will be brick lined, and will be 25 ft. in diameter by 350 ft. high.

Preparations for Reopening Plymouth Mines, California

San Francisco Correspondence

The new plant, composed of electric hoist, air compressor and pump, installed at the Pacific vertical shaft of the Plymouth Consolidated mines in Amador County, by the California Exploration Co., has been in operation since the middle of February. In the first 30 days the water was lowered to the 400-ft. point, and the timbering repaired to the same level.

The installation was begun on Oct. 15, 1911, and completed on Feb. 17, 1912.



Pacific Shaft, Plymouth Mines, California

It is estimated that it will be necessary to lift about 60,000,000 gal. of water before practical exploration and development can be undertaken. This estimate is made from a study of the available history of the underground workings and the amount of ore extracted in the 36 years' life of the mines, in which period the production totaled nearly $7,000,000. A concise history of the mines was published in the Journal.[1]

The Pacific shaft is 1700 ft. deep; the lowest working level is at 1600-ft. depth. So far as I have been able to learn this was the first deep vertical shaft on the Mother lode in Amador County. It was opened in May, 1880, and in two years had reached a depth of 1400 ft. It is in

[1]Eng. and Min. Journ., Jan. 20, 1912, p. 191.

three compartments, each 4x5 ft. in the clear, two of which were used for skips, the other for pump and manway. At the time of my visit to the mines in February the shaft had been sounded to a depth of 1265 ft. in the working compartments and found to be clear of débris. It is probable that from that depth to the 1350-ft. level the débris from the rotted timbers and rocks and earth from the caved formation have filled the space.

At the 1350-ft. level there is a bulkhead, put in at the time of the attempted reopening of the mines after the fire in 1888. The estimate of the quantity of water in the workings is based on the probability that one-half of the excavations is filled with rock and débris, the remainder with water. The water was running over the collar of the shaft, and when pumped out for a depth of the first 14 ft. the timbers were found to be badly rotted, though generally in place. The new timbers used in repairing the shaft are 12x12 in.; the shaft guides are 4x4 in. The water in two other (inclined) shafts on the property will be drained through the Pacific, which will be cleared to the full 1700-ft. depth, as it is expected that any extensive orebodies left in the mines will be found below the 1600-ft. level. The work of unwatering and timber repairs should be completed in August.

Hoisting and Pumping Equipment

The plant is operated by two General Electric motors, having a total of 325 hp., and supplied with electricity by the Western States Gas & Electric Co., of Stockton, brought in over a pole line at 60,000 volts and stepped down to 440 volts. The hoisting engine is 225-hp., direct driven, with capacity for lifting 300 tons per day, at the rate of 650 ft. per min. from a depth of 2000 ft. The pump is a No. 7 Knowles, capacity 100 gal. per min. and lifting through about 300 ft. It is operated by a Sullivan 500-cu.ft. compressor, belt-connected to a 100-hp. motor.

Two new Aldrich electrically driven plunger pumps have been ordered and will be installed immediately, one for a lift of 500 ft., the other for a lift of 1100 ft. The larger one will be stationed at the 1065-ft. level; the smaller one at the 1600-ft. level. At present two 550-gal. skips are employed in lifting water, but will be mostly used in repair work when the new pumps are installed. The cable hauling these skips is ⅞-in. plow steel. The machinery of the plant was manufactured by the D. D. Demarest Co., of San Francisco, in the shops at Altaville, near Angels, Amador County.

The gallows frame is an "A" type, 58 ft. high, 22x32 ft. at base, resting on concrete foundation. The timbers are of Oregon pine, 12x12 in. square. The hoist building is 40 ft. 8 in. by 48 ft. 8 in.; blacksmith shop, 24x16 ft.; timber shed, 40x24 ft.; all of corrugated iron; the powder house is 16x12 ft., built of brick; cap house, 5x5 ft., of concrete; change house, 20x12 ft., of brick.

The elevation at the Pacific shaft is 1200 ft., about 300 ft. lower than the elevation at the Kennedy mine near Jackson. Measured in geographical sections the Plymouth Consolidated is 8 miles north and 2 miles west of the Kennedy. It is in the west or foot-wall side of the Mother lode; the Kennedy is situated in about the center of the Mother lode between the greenstone hanging wall and the slate foot wall, and in the proximate geographical center between the north and south ends of the Mother lode in Amador County.

The Pacific shaft was sunk east of the vein in slate and intersected the hanging wall of this vein at 1400 ft. where 40 ft. of $16 milling ore were mined. The dip of the veins along the entire length of the Mother lode in Amador County is approximately uniform at about 60° E. The strike of the formation is west of north and east of south. The greenstone croppings of the hanging wall of the lode in the Plymouth district are 1500 to 2000 ft. east of the Pacific shaft.

There are other mines in the Plymouth district to be described in a separate article respecting their development and, as in the present writing, with only a general reference to the geological formation. Plymouth represents the northerly end of the Mother lode mines in Amador County, but the lode extends into Eldorado County where there is present extensive development and mining in progress.

The preparation for development of the Plymouth Consolidated is attracting attention to the possibilities of reopening other old mines in the district, and will probably lead to prospecting for new veins and ledges. The work at the Pacific shaft is under the direction of Albert Burch, Crocker Building, San Francisco, representative of Bewick, Moreing & Co. of London, managers of the California Exploration Co. J. F. Parks is superintendent, at Plymouth.

Shell Transport & Trading Co.

The aggressive Shell Transport & Trading Co., not content with alliance with the Royal Dutch Co., has now bought 80% of the Société Caspienne et de la Mer Noir and the Société de Mazut, says the *Petroleum Review*, Feb. 24, 1912. A further issue of stock will be necessary to finance this purchase, and the directors will call for *pro rata* subscriptions from the present stockholders at 65s. per share for the unissued 510,000 shares of the 3,500,000 authorized. The new move is expected to strengthen the Royal Dutch Shell hold on Russian markets.

A New Iron Ore Deposit in Pennsylvania?

Under this head, mention was made in last week's JOURNAL of the reported discovery of a fabulous quantity of supposedly limonite and hematite iron ore, in Fulton County, Penn. At that time such information as was generally available was given. It now appears that the U. S. Geological Survey detailed a geologist to make an immediate examination, for which great credit is due; the result of Geologist George H. Ashley's investigation is interesting.

Presence of Iron Ore Long Known

According to Mr. Ashley, Dickey's Mountain, Laurie's Knob and the Meadow Ground Mountain, in Ayr Township, Fulton County, Penn., have been known as iron-bearing for about 100 years. The descriptions given in the earlier reports by Rogers in 1858 and Stevenson in 1886, as regards structure and iron content of these hills, are, in the main, confirmed by Mr. Ashley. It is stated that Dickey's Mountain contains a little sandy, Clinton hematite, a little limonite, containing 38% iron and abandoned after a short trial by the old Hanover furnace, and a little bog ore. Laurie's Knob has yielded between 60,000 and 80,000 tons of 46% limonite ore from a group of pits on the east side. The largest of these pits may not have been worked out and other pockets may be found, although this is considered not likely. A little ore also occurs on the west side of the knob, as on Dickey's Mountain. The Meadow Ground itself is a poorly drained flat in a shallow, canoe-shaped synclinal basin of red Mauch Chunk rocks, covering about 1000 acres in the center of a basin of Pocono sandstones, forming the mountains on either side, with all dips toward the center. This flat lies between Meadow Ground Mountain and Scrub Mountain.

A large fault runs through Laurie's Knob and Dickey's Mountain, throwing the rocks on edge and partially crushing them, but there is no evidence of "volcanic action." The old geological reports state that the Hanover furnace, near the gap between Dickey's Mountain and Laurie's Knob used iron from these hills 90 years ago. That furnace shut down in 1847, having found the ore of Dickey's Mountain too low in grade and too thin, and that in Laurie's Knob apparently having been exhausted except possibly in the deepest pit. No commercial mining has been done on the Meadow Ground, and the recent excitement appears to have been due to the drilling of three holes there. In the center of the basin is a thin group of red shales and some red sandstone, which show everywhere in the Meadow Ground. The bottom of the group outcrops around

an area about 3½ miles long and ½ mile wide, including the maximum area of about 1000 acres mentioned above. The drilling has gone into these red rocks. At surface the latter show practically no iron except the coloring of the rocks, and therefore cannot in any way be considered as iron ore. Using the dips and known area at the surface, this group, it is stated, may have a volume of 300,000,000 cu.ft. Assuming 10 cu.ft. per ton, if the red rocks pierced by the drill were solid ore, the total tonnage would not exceed 30,000,000 tons.

Dickey's Mountain

Dickey's Mountain is about eight miles long and is in Ayr and Thompson Townships in Fulton County. The crest is hard, white Medina sandstone, and on the west side are Clinton rocks, such as contain the red Clinton iron ore at points between Lake Ontario and Birmingham, Ala. Fragments of red sandy ore or ferruginous sandstone are found scattered locally over the western slope of this mountain; when traced they appear to come from one or possibly two layers in the Clinton formation. The largest blocks seen are stated to indicate a thickness of these layers of at least 4 ft., in places. Similar iron-bearing sandstone or sandy iron ore is common elsewhere in the Clinton formation. It is stated that a bed of this iron ore, averaging 4 ft. thick for a distance of three miles, on the west side of Dickey's Mountain, will carry about 5000 tons of ore for every foot of depth. However, just west of the outcrop is the Great Cove fault, which is a break in the rocks and runs entirely across Fulton County; the Clinton rocks cut off against this fault. With a liberal allowance of 1000 ft. in depth before the bed strikes the fault, the bed will, so it is stated, contain 5,000,000 tons of ore. The average thickness of the bed may be less or greater than 4 ft.; a similar ore in Virginia has been found 20 ft. thick. At present this ore is not generally considered of commercial use, as most of it will not carry more than from 10 to 25% metallic iron. The best of it may possibly run to 35% and a few picked specimens might run as high as 40 per cent.

Laurie's Knob

Laurie's Knob, less than one mile long, is a northern extension of Dickey's Mountain, and is separated from it by the gap of Big Spring Run. The rocks, fairly well exposed at each end of the knob, are hard Medina sandstone on the crest, Lower Silurian shales and limestones on the eastern slope, and a little Clinton formation on the west slope at the south end, the balance of the west slope being composed of Devonian shale, sandstone and limestone. The old Hanover furnace worked out two large and several small pockets of brown ore on the east side. Prospect pits sunk in the bottom of the largest pocket are said to show 18 ft. of ore still in sight. The presence of one pocket suggests, it is stated, the possibility of more, but as such pockets are usually formed only at the surface, it is said that if they exist, they should have been found before this. According to Rogers and Stevenson, the ore in this pocket gave 46% iron. During 27 years the furnace is said to have smelted a total of between 30,000 and 40,000 tons of iron ore. If the entire Laurie's Knob were all iron ore, it could hardly contain over 100,000,000 tons.

The Hanover furnace also did a little work on a cellular brown ore in soft, yellow-bluish shales on the west side of Dickey's Mountain; according to Rogers, the ore ran from 14 in. to 2 ft. thick and carried 38% iron. Drilling on the west side of Laurie's Knob is said to have passed through 30 ft. of iron ore, but as the rocks are nearly vertical, these 30 ft. may represent only a foot or two of actual thickness.

It is hardly necessary to comment on the analyses of the ores when it is recalled that brown ore, when chemically pure, has less than 60% of metallic iron and the carbonate of iron, when chemically pure, has less than 49% of iron, and ordinarily runs much below that. Hematite, when pure, has practically 70% and hematite ores are frequently found running over 60% of metallic iron. The only hematite found in this region, in the Clinton formation, has only to be tested by the hand to realize the difference in weight between it and a high-grade hematite ore.

This is merely a broad general statement of the case without going into the details, which would require maps and sections, but is sufficient to show why the geologist finds it difficult to substantiate the figures given in the press dispatches.

Rescue Car Wanted on Iron Ranges

The miners in the employ of the United States Steel Corporation on the Mesabi and other ranges have followed the lead of the underground workmen in the Marquette district, and have circulated petitions, which will later be presented to their Congressmen, asking that the government provide instruction cars in the use of safety apparatus, to be operated under direction of the Bureau of Mines, at the expense of the government. Such cars are maintained in the Eastern coal districts, and it is desired to obtain at least one car for the Lake Superior iron region.

The larger iron-mining companies have lately purchased rescue outfits, including Draeger apparatus and pulmotors, their attention having been directed to such a need by the fire in the Hartford mine, of the Republic Iron & Steel Co., at Negaunee, last spring, when seven men were killed.

The Oliver Iron Mining Co. has established rescue stations on the several ranges as follows: Ishpeming for the Marquette range; Hibbing and Eveleth on the Mesabi; Ely on the Vermillion; Ironwood on the Gogebic; Iron Mountain on the eastern Menominee, and Iron River on the western Menominee. An expert visited all these stations and instructed selected crews in the use of the apparatus, but a more detailed knowledge is desired by the miners as a whole. The officials of the mining companies are favorable to the demand for a government car.

February Operations at Goldfield Consolidated

During February, the total production of the Goldfield Consolidated Mines Co. was 27,641 tons, containing $740,793, an average of $26.80 per ton. This was milled with an average extraction of $25.08 per ton or 93.57%. The total net realization was $487,261, or $17.64 per ton. Development work totaling 2869 ft. was done during the month.

The total mining, development, milling, office and general expense was $7.47 per ton, distributed as follows:

OPERATING COSTS AT GOLDFIELD CONSOLIDATED FOR FEBRUARY

Mining:		
Development	$0.96	
Stoping	2.62	
		$3.58
Transportation		0.09
Milling		2.19
Marketing		0.33
General expenses		0.48
Bullion tax		0.26
Construction		0.54
Total cost of operation		$7.47
Miscellaneous earnings		0.03
Net cost per ton		$7.44

General Superintendent Thorn states that at the Clermont the sill of the 428 stope between the 600- and 750-ft. levels was extended and produced 561 tons of average $48.57 ore. The 604 raise from the 1000 ft. level produced 472 tons of average $93 ore. At the Mohawk the 3-E sill on the 150-ft. level, near the old Sheets-Ish workings, was extended and produced 59 tons of average $17.57 ore. The 3-D sill on the same level was also extended along the south end of the Sheets-Ish old workings and produced 70 tons of average $70.27 ore. The No. 29 drift, being cut around the 3-E stope in the foot wall, encountered the extension of the 3-E ore, and produced 30 tons of average $15.30 ore. The 111-M sill was extended and produced 854 tons of average $14. 67 ore. The 415-X crosscut between the 450- and 600-ft. levels produced 198 tons of average $41.13 ore. The 491 sill produced 111 tons of $23.35 ore.

At the Red Top the 353 intermediate, between the second and third levels just north of the shaft, was extended and produced 90 tons of average $41.34 ore. Work through the Red Top shaft has been discontinued, the Laguna surface plant and shaft now serving both mines. At the Combination the 292-O sill, being cut from the 295-X crosscut on the fourth level south, and west of the Hampton stope, produced 138 tons of average $20.87 ore.

United States Smelting, Refining & Mining Co.

The United States Smelting, Refining & Mining Co. operates the Mammoth copper mines and smeltery and the Needles lead and copper smeltery in California; the Gold Road mine in Arizona; the Real del Monte y Pachuca mines and cyanide plant in Mexico; the United States Mining Co., in Utah; an electrolytic lead refinery at Grasselli, Ind., and a copper smeltery and electrolytic refinery at Chrome, N. J.

The net earnings of all companies, except for depreciation allowance, for 1911, were $3,961,103; depreciation allowed was $1,120,690; leaving a net profit of $2,840,413. Of this $1,702,120 was required for the 7% preferred-stock dividends, $702,210 for 4% common-stock dividends; $339 for dividends on minor stock of subsidiaries; leaving $435,744 to be carried to surplus, which amounted to $2,230,640 as at Jan. 1, 1912.

Metals produced during the year, including custom ores and Mexican production, and the percentage of the total production value, were: Copper, 22,199,141 lb., 21.48%; lead, 49,022,791 lb., 16.81%; silver, 10,285,150 oz., 42.72%; gold, 118,703 oz., 18.99%. The metals sold for: Copper, 12.459c. per lb., lead 4.428c.; silver, 53.815c. per oz. The total production of company ores was 1,037,685 tons of ore, in which the value of the metals was in the proportion: Copper, 38%; lead, 6%; silver, 35%; and gold, 21 per cent.

Charges to capital account for 1911 were: Mine properties, $1,806,585 (including purchase of Gold Road mine); addition at Mexican and Needles plant, $499,510; additions at Chrome and Grasselli, $69,987; miscellaneous, $115,996. The excess of current assets over liabilities is shown at $7,641,512.

Shipments of lead ore from the mines at Bingham amounted to 99,500 tons; of copper ore, 176,800 tons. More ore was developed than was extracted, as was also the case in the Centennial-Eureka, where the production was 108,275 tons. Some development work was done in the Bullion Beck & Champion mines, but no large orebodies were found. Development will be continued in what seems to be promising territory. The Richmond-Eureka company was idle during the year, as the railroad was not rebuilt. It is hoped that this company will resume operations in 1912. The Niagara Mining & Smelting Co., in which the U. S. company holds the majority interest, has been reorganized, and will resume operations.

The Midvale smeltery ran steadily, the bag-house taking care of all fumes. Both the Huff electrostatic plant and the concentrator ran on larger tonnages. The Mammoth plant operated three furnaces steadily without damage to the surrounding vegetation. Experiments are in progress on the utilization of the bag-house products, but although progress has been made, a satisfactory solution has not been found. The ore tonnage developed is almost equal to that extracted, and the indications for future orebodies are favorable. The Mammoth company holds the Original Quartz Hill mine under lease, which furnished the smeltery with 29,412 tons of siliceous low-grade ore, as flux.

The Gold Road mine in the Kingman district, Ariz., and a 40-stamp mill, were taken over in July, 1911, and efforts directed toward opening up the mine in depth and on the strike, and to lowering costs.

CONSOLIDATED BALANCE SHEET, U. S. S. R. & M. CO., at Dec. 31, 1911

Assets

Costs of properties	$44,066,883
Shares held for exchange for stocks of other companies	2,287
Deferred charges	504,218
Metals on hand and in process	3,203,288
Ore, matte and byproducts	1,116,295
Supplies, fuel and timber	1,225,454
Accounts and notes receivable	1,490,117
Cash and call loans	2,787,955
	$54,396,497

Liabilities

Common stock	$17,553,788
Preferred stock	24,313,725
Minority subsidiary stocks	1,032,899
Surplus applicable to same	174,199
Outstanding 5% notes	4,000,000
Current liabilities	2,181,597
Depreciation funds	2,829,352
Exploration fund	80,297
Profit and loss balance	2,230,640
	$54,396,497

The Grasselli refinery operated at a marked reduction in cost, and about the same output. The Chrome refinery worked on increased tonnage, with lower costs.

The Needles plant was run intermittently, as there was not the hoped-for increase in mining activity in the tributary country, and the company mines, which yielded the bulk of the ore, could not keep the concentrator and smeltery busy. The Tennessee mine is down to the 700-ft. level, with encouraging results. The zinc extraction from this ore is satisfactory.

At the Pachuca plant, power service was again good, and large tonnages of milling ore were opened up. The capacity of the mills was raised from 600 to 1200 tons per day.

Offices of the exploration department were opened in Seattle and the City of Mexico. In 1911, there were 921 properties considered. Of these only 144 were good enough to warrant field examination, 28 were subjected to a complete sampling and examination, and one was taken over.

Heated Areas in Culebra Cut

A peculiar phenomenon was observed recently in the Culebra cut on the line of the Panama Canal. Steam was seen coming from a bank of blasted ground, in which considerable heat had developed. Under date of Feb. 12, 1912, states *The Canal Record,* the division engineer of the central division reported as follows:

A little less than three weeks ago I noticed that the material, which consisted of stratified, sedimentary rock, in which there appeared some lignite of low grade, was sending up in the early morning a thick cloud of white steam. I examined the spot a day or two afterward and found that for a width of about 20 ft., length of about 100 ft. and a depth of about 15 ft., the entire mass of material appeared to be heated to a considerable temperature. Steam was escaping from numerous small openings and from four principal vents, or openings; the smallest of the four being about 3 in. in diameter and the largest about 1 ft. The temperature was so high that the hand could not be held at the mouth of the larger openings for more than a second or two, and when withdrawn was quite moist, showing quite unmistakably the presence of steam or heated vapor. The sides of two of the vents were encrusted both with white and yellow powdered material, the yellow appearing to be sulphur.

I have observed this place almost daily for over two weeks, and within the last four or five days there has been a change in two important characteristics. The temperature has increased and a pale blue smoke, instead of steam, is now emerging from the vents. The odor of sulphuric acid, which was marked when only steam was emerging, is fully as marked today. To give an idea of the temperature of the larger vent I took a 9-in. brown manila envelope and held it at the mouth of the largest vent for three seconds; it was totally destroyed although it did not ignite in flame. I then took a piece of the white pine covering of a dynamite box and held it for three minutes within the mouth of the largest vent and on withdrawing it, it was completely charred, so that another three or four minutes' exposure would probably have carbonized it completely.

We have had premature explosions in the past on at least two occasions due to chemical heating of the rock, and I am convinced that the material which I have described was hot enough to have readily fired dynamite at any time within the last three weeks.

The commission geologist, D. F. MacDonald, made an investigation and stated that the marl shales, through which Culebra Cut extends, are dark, thin bedded, soft and easily crumbled, and some of the layers are largely fine tuff, or volcanic ash, loosely cemented by lime. Other beds contain more carbonaceous material, with some local partings of lignite, an inch to a foot or more thick. A large sample of the shale was crushed and panned, a concentrate of pyrite in

very fine grains being obtained. This indicates that the oxidation of the finely disseminated pyrite is the cause of the phenomenon, and that it may develop enough heat to cause further rise of temperature by the oxidation of the carbonaceous matter in the shale.

The Situation in Mexico

SPECIAL CORRESPONDENCE

The revival of mining throughout Mexico, which hesitatingly began in the autumn of 1911, after Madero's accession to the presidency, had gained full headway at the time of the beginning of the present disturbances, about February 1. There were, it is true, serious labor difficulties in many of the camps, but the operating mining companies were meeting these conditions by compromise and adjustment, and generally were preparing to carry on an increasing program of operation. The silver mines particularly were encouraged by the advance in silver and were planning to take advantage of it by larger output. Then "like a thunder clap out of a clear sky," as one mine manager expressed it, came the disturbances in the north and the increased activities of the rebels in the south. Along with this came a distrust and lack of confidence in the government among the Mexicans themselves that was not easy to explain. The Americans too became "frantic" in their state of mind, if this word may be used, with the prospect of more revolutionary conditions. They recalled too many individual cases of personal danger and humiliation to be philosophical under the prospect of a repetition of their experiences during the Madero revolt. The exodus of Americans and their families from Mexico began in February and has continued increasingly since. The uncertainty that preceded the troubles was soon followed by the closure of the railroad at Torreon and the quick crumpling of the regular government authority in all of the state of Chihuahua, and the spread of the "rebel" control over practically all of the northwestern states. Sporadic manifestations against the government on the Pacific coast, at Tampico and elsewhere were also frequent and the authority of the constitutional government was flaunted in nearly all of the region south of Mexico City.

These political and psychological conditions have had their direct effect upon the mining industry of the country. Since February the Americans and their families (the families in particular) have been fleeing from the country by the thousands. Many of them are remaining on the border in hopes of returning at an early date, while others are cutting loose and seeking other connections for their activities. In many cases the responsible managers feel it is necessary to remain at the properties as a matter of duty, and generally they are doing so, utilizing such native labor and skill as are available to continue operations in a limited way.

The hopes of the silver-mining camps to realize the advantage of the increase in silver have been largely frustrated, and the whole industry is in a state of uncertainty which will surely tell in the dollars and cents account of the annual reports.

In the Chihuahua country most of the mines have been cut off from direct communication nearly eight weeks, and in the absence of any definite data, it is impossible to tell just how much damage has been done to the industry.

In general there is no concern over the validity of titles, but most of the companies in the north have suffered considerable loss by way of "contributions" to the rebel army, and it is hard to tell whether any of these losses will be repaid.

Even if the actual financial losses are reimbursed ultimately, the loss in disorganization and cessation of continuous activity will be a matter of many million dollars to the mining industry of Mexico.

And what of the future? *Quien sabe!*

Report on the Landslide at Frank, Alberta

On April 29, 1903, a landslide occurred at Frank, Alberta, causing the loss of 70 lives in the town and the destruction of much property including 7000 ft. of the Crows Nest Ry. The slide occured on the north side of Turtle Mountain which is due south of the town. As it appeared quite possible for further sliding to take place, which might not only destroy the town, but shut off the coal mines west of Frank and perhaps permanently close the Crows Nest pass, a commission was appointed by the Department of Mines, of Canada, to make an investigation. The report[1] of the commission, which consisted of Reginald A. Daly, W. G. Miller and George S. Rice, has recently been published and recommends the abandonment of the Frank townsite.

The geological profile of Turtle Mountain shows that the foot on the northern side is made up of beds of sandstone interbedded in shale. The beds dip towards the west at a high angle. These beds are bounded on the north by a thrust plane dipping westward at an angle of about 50° and which is the plane of contact of the shale-sandstone beds with the limestone that forms the major portion of the upper part of the mountain. The limestone dips to the west at an angle of about 50° and lies unconformably on the shale. A short distance above the thrust plane the limestone beds are contorted in what are known as the contorted zones. The limestone is jointed, the joints running at right angles to the dip and continuing to the thrust plane.

Two coal mines are operated along the foot or east base of Turtle Mountain. The seam is nearly vertical and is in the shale series. Both mines are the property of the Canadian Coal Consolidated, Ltd., and formerly belonged to the Canadian-American Coal & Coke Co. The strike of the seam is north and nearly parallel to the long axis of Turtle Mountain. Mining was started in 1901 and prior to April 29, 1903, the walls of part of the worked out portion of the southern end of the seam had caved. The joints in the limestone appear from the profiles prepared by the commission, to dip directly towards, but not to continue as far as, the main coal seam. The slide seems to have taken place in a direction approximately parallel to these joints.

The commission regards the slide as having been caused by natural conditions and by the mining operations in the coal seam. Excepting at the places known as the North Peak block and South Peak block and the fissured ground between them the commission is not of the opinion that the danger of more heavy slides into the Frank valley is imminent, but states that it is impossible to deny the existence of danger in certain places. The course of future slides would probably be in the already mined and now uninhabited area covered by the 1903 slide. It has designated a certain area of the coal seam as lying within a zone of danger from further landslides and on account of the unstable condition from natural causes, has recommended the abandonment of the townsite of Frank whether the coal seam is worked in the danger zone or not.

Dispatches from Frank on Mar. 30 state that serious slides are taking place. Much alarm is being felt in the town and many people are reported to be moving out of the danger zone.

[1]Memoir No. 27, Canada Department of Mines.

High Tension Cables Underground

To mines dependent on high-tension transmission lines for power, there seems hope of escape from interruption by storms, in the announcement that two underground cables for a pressure of 60,000 volts have been laid on the German railway between Muldenstein and Bitterfeld. As such high pressures have hitherto been exclusively used in connection with overhead lines, it is considered (*Engineer*, Feb. 16, 1912) that the present experiments will be of particular interest. One of the cables has aluminum for the conductor, while the other is a copper cable. The cables are laid in conduits filled with dry sand.

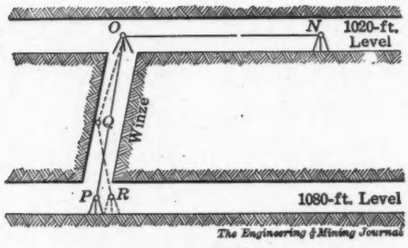
Details of Practical Mining

Accounts of Useful Ways of Doing Many Things in the Day's Work

Back Sighting in a Winze Survey

Many of the difficulties encountered in underground surveying are of an unexpected nature, and owe their origin to awkward workings or other conditions that have to be overcome by the ingenuity of the surveyor. For example, in surveying for a proposed raise between the 1020- and 1080-ft. levels in a large tin mine with an instrument known as the Henderson rapid traverser, a difficulty presented itself which was overcome in the manner to be described.

The start was made from two pegs placed in the "back" of the 1020-ft. level, and near the place where it was desired that the raise should hole through. The survey was then carried on by the aid of two stands to a point some 480 or 540 ft. west of the starting point on the top of a narrow winze.



THE LIGHT *O* CAN BE SEEN FROM *Q* AND *R*, BUT NOT FROM *P*

The difficulty which arose can best be appreciated by reference to the accompanying sketch. After placing the instrument on the stand set up over the winze at the point marked *O* and taking a back sight to the stand at *N*, this back stand was brought on and set up in the 1080-ft. level on the point marked *P*. It was then found, however, that while the direction *O* to *P* could be recorded on the disk of the traverser, it was impossible in consequence of the narrow winze, to make a back shot from *P* to *O*. As a matter of fact, while the candle on the stand at *P* could be quite easily seen from the instrument at *O*, it was quite impossible to see the candle at *O* when the instrument was fixed on the stand at *P*.

In consequence of this unforeseen difficulty the surveyor came to the conclusion that it was necessary to do the survey over again, but this course was strongly objected to by the underground manager, on account of the prolonged hindrance to the trammers that would be caused by this extended survey. It will easily be seen that had there been three stands in use instead of two there would have been no serious difficulty inasmuch as the head of the instrument could have been again fixed on the stand at *O* and the back sight taken to *N*. Under the conditions existing, therefore, it was decided, after some little consideration, to proceed in the following manner: The head of the instrument was brought up from *P* and fixed to the stand at *O* and, the alidade still remaining clamped, a sight was taken to *P*. This brought the alidade and the disk of the instrument into exactly the same position as they had after the original foresight to *P* had been taken. The alidade was then unclamped and its fiducial edge was brought into line with the line *N* to *O* which was already marked on the disk. It will be apparent that in this way the alidade was brought back into the position it had occupied before taking the shot down the winze to *P*. As shown above the line or course adopted to reach *P* proved a failure and it therefore became necessary to adopt a new route down the winze as shown by the dotted lines *OQ* and *QR*. With this alteration the survey was finished, and the subsequent successful carrying out of the raise showed that even with this complication in the survey, it was performed with the necessary degree of accuracy. In this particular case the advantage of the rapid traverser over the ordinary theodolite or dial is marked.

Facts About Explosives

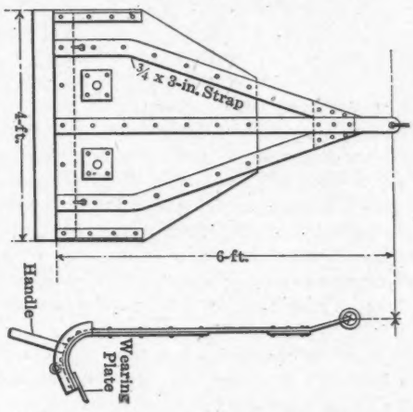
According to a bulletin[1] of the U. S. Bureau of Mines, "high" explosives are those that usually act by detonation; "low" explosives, those that act more slowly. Detonation is practically instantaneous combustion. Compared to detonating explosives, "low" explosives take an appreciable period of time to develop maximum pressure.

Dynamites consisting of kieselguhr, chalk or other inert substances impregnated with a large proportion of nitroglycerin have been almost entirely replaced with an active base consisting usually of sodium or potassium nitrate, wood pulp, sawdust or charcoal, practically a low-grade gunpowder. About 1% of calcium carbonate is added to neutralize any acid that may be developed during storage. The nitroglycerin fires the gunpowder mixture which serves to still further expand the gases produced by the detonation of the nitroglycerin.

[1]Bull. 15, U. S. Bureau of Mines.

Scraper for Cleaning Stopes

The stopes of the Calumet & Hecla mine dip at about 38°. The empty stopes are not filled and after the stoping is finished, a considerable quantity of ore is left clinging to the floor, especially if the floor is at all rough as is the case in the amygdaloid mines, where the ore often makes off along the foot wall. In the conglomerate stopes less trouble is experienced from rough foot walls; most of the ore that piles up in the stopes is held by the rolls of the foot wall.



A LAKE SUPERIOR STOPE-FLOOR SCRAPER

This ore, when there is not much to be handled, is worked down to the level by hand, it being shoveled and scraped along. When much ore has accumulated on the floor, it pays to use the scraper, the construction of which is shown in the accompanying drawing. A sprag is set in the top of the stope, and a small air hoist is installed at the bottom. The rope that goes from the hoist to the rear end of the scraper passes through a pulley carried by the sprag, while another rope from the hoist goes directly to the front ring of the scraper, so that the air hoist, besides pulling the scraper with its load of ore in front of it to the bottom of the stope, also pulls it back again. The scraper works well when the foot wall is not too rough and practically no hand shoveling of the ore is necessary, but if the ore lies in pot holes in the foot wall, it must be shoveled out to a smoother part of the foot wall, where the scraper

can get at it. This scraper was designed by Mine Captain Samuel Richards, of the Calumet & Hecla company, and has now been in use for several years, both in the amygdaloid and in the conglomerate stopes.

The main plate of the scraper is $\frac{5}{16}$ in. thick, and is strengthened by means of three 3x¾-in. iron straps that come together near the front, so as to distribute the load to the haulage strap. A ring is provided for fastening the rope from the hoist to the front end, while at the rear is a chain that is fastened to two eyebolts that go through the two outside straps. To this the return rope is fastened. There are also riveted to the rear of the scraper two plates carrying two handles. By means of these handles the men are able to steer the scraper, and by pulling up or shoving down on them regulate the quantity of ore that the scraper takes on its trip down the stope. In case the scraper has a tendency to ride over the ore, owing to the compact way in which it lies on the foot, car wheels can be hung on these handles, and the scraper made heavy enough to dig into the pile of ore.

Maintenance of Generators and Motors*

By A. Kelly

Commutation is probably the weakest point of a direct-current machine. Bad commutation is brought about in a variety of ways, but the remedies are often simple. Imperfect commutation is often brought about through brushes being too wide, a very weak field in the case of a motor, eccentricity of the commutator, flats on commutator, dirt or oil, and high mica.

Two motors, one of 30 and the other of 60 hp., on their trial run, sparked so badly at the brushes that it was found impossible to keep them running. The trouble was in the brushes. This was remedied by reducing the cross-section of the brushes by cutting away a piece ⅛ in. thick the full width of the brush, and making up with a packing piece, in order to insure the brushes still fitting the holders.

High mica is often one of the most difficult faults to detect, and in this connection I will mention my experience with three 7-hp. motors, which were connected to pump gear. The motors were installed in a comparatively dust-free place and were comfortably loaded. Excessive brush consumption was the principal annoyance. When cold, a close examination of the commutators revealed nothing out of the ordinary, but after careful examination of the mica between the segments, before and after extended runs, it was found that the mica had been forced up, presumably through the varnish with which it was cemented together expanding when heated. The mica was cut out about $\frac{1}{32}$ in. below the face of the segments, and the result was perfect commutation with a set of brushes lasting six months instead of a week. This trouble often occurs in very large commutators, in which "built-up" mica is used. It is easily cut down by a knife, file or small carborundum wheel on a flexible shaft, such as is used by dentists.

The hardness of brushes affects commutation, frequently making a big difference in the maintenance cost of a machine. Brushes which were operating on the rings of a turbo set, with a peripheral speed of 7000 ft. per min., required replacing after 32 hours' run. Harder brushes were used, with the result that 4000 hours' run did not terminate the useful life of the brushes.

Bearing on the question of the wrong grade of brush for any particular machine, some engineers are in the habit of varying this order of things by mixing indiscriminately a great variety of grades, makes and sizes, sometimes with good, but generally with bad results, due to brushes of low resistance taking excessive current, glowing and softening the brush springs. A ready method of increasing the resistance of a brush is by cutting a slot, with a hack saw, parallel to the commutator bars, and midway in the face of the brush, to a depth which will just reach the brush holder from the face of the commutator.

The way in which brushes are ground in is worthy of attention, for badly ground brushes will set up sparking on the best machines. Grinding in can be expeditiously carried out by lapping completely round the commutator and over itself again to the extent of two brush arms, a strip of emery cloth. The machine may then be barred or otherwise turned the few revolutions generally required for the grinding in. On large commutators it is customary to use a cloth wide enough to overhang the commutator sufficiently to allow a No. 18 copper wire to be passed several times around this overhang and then be fastened to one of the commutator bolts, in order to prevent slipping of the cloth.

It sometimes happens that an armature coil will short-circuit and burn out in a machine, and, although machines are usually laid up on this account, it is not always necessary. In many instances the coil may be cut through, the ends well and carefully taped apart, and the coil segments bridged over. A temporary repair of this kind will run for weeks. Great care must be taken when next running the machine, after cutting the coil, to see that the machine does not overheat; otherwise further faults and extensive damage might be the result.

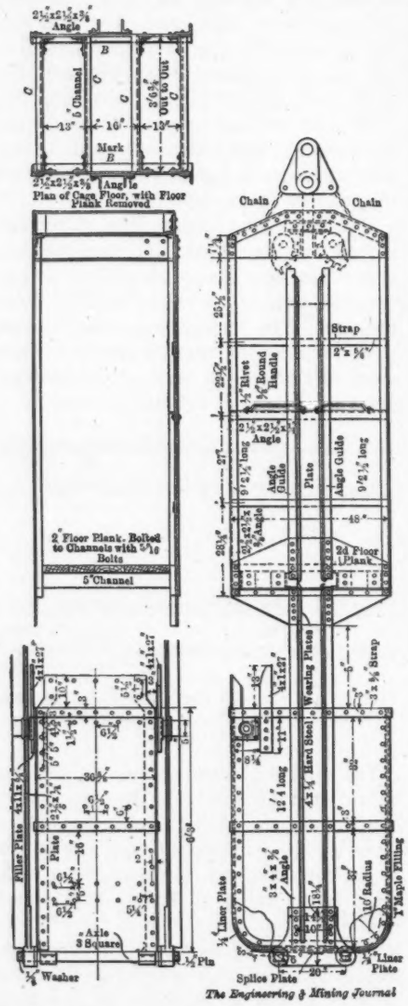
One of the most important points about the upkeep of electric equipment is cleanliness, and it is generally the least attended to. Of course, there are certain situations where it is impossible to keep clean the type of machine installed. For instance, it is not unusual to see open-type machines in use in dusty places instead of totally inclosed motors, the former often being unrecognizable under the deposits of dirt and dust.

*Abstract from a paper read before the Victorian Institute of Electrical Engineers.

Hiawatha Mine Cage

By H. L. Botsford*

In the accompanying illustrations are shown a type of cage and safety catch much used in the Lake Superior iron dis-



Hiawatha Cage with Skip Attached

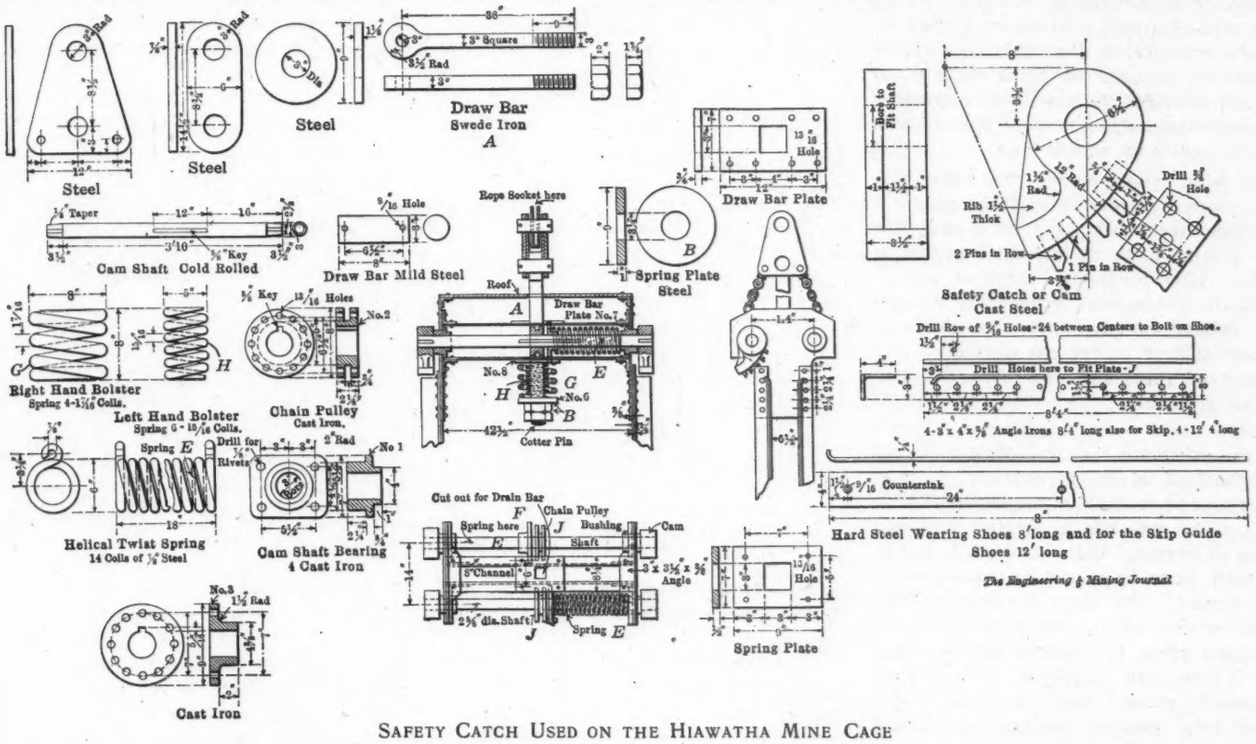
tricts. The principle of operation of the safety catch is the same as that of a Lake Superior Copper-country safety catch described in these columns, P. 636 issue of March 30, 1912, although the arrangement of the springs is different.

The draw bar *A* is free to slide through the crosshead or supporting frame, until the cage is carried by the plate and jamb nuts *B*. Chain connections be-

*Mining engineer, Creighton Mine, Ont.

tween the draw bar and the cam shafts, cause the latter to rotate when the draw bar is raised. The springs *E* are of the helical type and are placed concentrically around the cam shafts, one to each shaft. The springs are fastened to the side of the cage and to collars *F* keyed to the shafts. Any rotation of the shafts produces a torsional stress in the springs. Should the hoisting rope break the cam shafts are turned into such a position that the cams are brought into contact with the guides and cut into them sufficiently to stop any downward motion.

This cage is also provided with two bolster springs *G* and *H*, one within the other and both concentric around the draw bar. Their purpose is to lessen the strains in the hoisting cable due to a too sudden starting or stopping of the cage, and also to draw down the drawbar in case of the failure of the hoisting rope, thus permitting the full force of the camshaft springs *E* to be expended in forcing the cams into contact with the guides. There are several holes in the chain pulleys *J*, and the spring collars *F* for the fastening of the chains *K* and the springs *E*. This permits of careful adjustment to secure the proper tension in the springs *E*. The cage is substantially a type made by the Lake Shore Engine Works of Marquette, Mich., and is shown with a Kimberley skip attached below it, for hoisting ore.



SAFETY CATCH USED ON THE HIAWATHA MINE CAGE

Zinc dust for use in the precipitation of gold from cyanide solutions should be fine enough at least to pass a 200-mesh screen.

Rate of Burning of Fuse

After a thorough investigation of the rate of burning of fuse, W. O. Snelling and W. C. Cope of the U. S. Bureau of Mines have published[1] the following practical conclusions:

It is important that time fuse should have a uniform rate of burning, and in almost all blasting operations the fuse that is used is assumed to burn in a regular and uniform manner. When fuse has been subjected to such conditions as produce acceleration or retardation in its rate of burning it becomes dangerous. Acceleration of the rate of burning increases the liability of a shot going off before the miner has left the face; retardation increases the chance of the flame in the fuse progressing so slowly that the miner will be injured by a delayed shot when he returns to the working face. All conditions that bring about any marked change in the rate of burning of fuse are dangerous, and from a study of the list of accidents in mines and quarries each year injury and loss of life are seemingly often brought about by such conditions.

Under ordinary conditions nearly all types of fuse show great uniformity in their rate of burning. Practically all types of fuse examined in connection with the preparation of this report had a total variation in their rate of burning under normal conditions of less than 20% and all would have been passed under the allowance of "no variation greater than 10% above or 10% below the average rate of burning."

[1]Technical Paper 6, Bureau of Mines.

Under the influence of pressure practically all types of fuse are subject to wide variation in their rate of burning. Such pressure as can readily be produced by the confinement of the gases evolved by the burning fuse itself is sufficient to increase the normal rate of burning from 92½ sec. per m. (28.2 sec. per ft.) to 21 sec. per m. (6.4 sec. per ft.). Thus, even confinement will cause fuse to burn from three to four times as rapidly as its normal rate. In experiments made with fuse confined by stemming of various kinds wide variations in the rate of burning were noted, and whenever lengths of fuse are confined by stemming or other materials impervious to gas, a sufficient length of the fuse should be used to allow for the increased rate of burning due to the pressure produced by the evolved gases.

High temperature causes a marked retardation in the rate of burning of fuse, and storage for even a short period of time near boilers, or wherever the temperature may be high, is sufficient either to cause "misfires," or to retard the rate of burning of the fuse so much as to greatly increase the liability to "hold-backs," delayed shots, etc. It is probable that many of the difficulties that are sometimes encountered in regard to fuse burning too slowly and causing delayed shots are due, in part at least, to such fuse having been kept in too warm a place. Fuse that is not intended for use in wet places (cotton fuse, etc.), does not suffer marked change in its normal rate of burning by reason of the effect of high temperatures, whereas the more com-

pletely waterproofed types of fuse show increasingly great effects from heat. Even exposure to comparatively low temperatures for considerable lengths of time causes marked retardation in the rate of burning of such fuse, and exposure to a fairly high temperature for even a short length of time may cause certain types of fuse to burn from three to five times as slowly as their usual rate. To insure the best results, fuse should always be protected from extremes of temperature.

Climate conditions affect to a considerable extent the rate of burning of the less waterproof types of fuse. Damp fuse burns more slowly than normal fuse, and fuse that has been wet and then thoroughly dried tends to burn at a rather slow rate, and may even cause delayed shots by smoldering for a considerable time. Fuse containing several wrappings of tape saturated with tar or asphalt resists moisture to a considerable extent, and may be used for firing shots under water, provided the fuse is not allowed to remain too long a time in contact with water before the shot is fired.

It is, of course, evident that when these waterproof types of fuse do become wet, whether through storage for a long time in a damp place or through exposure to water after protecting layers of asphalt or gutta-percha are mechanically abraded or injured in any other way, they are more difficult to dry out than are other types of fuse, and are more liable to burn at a rate slower than the normal rate.

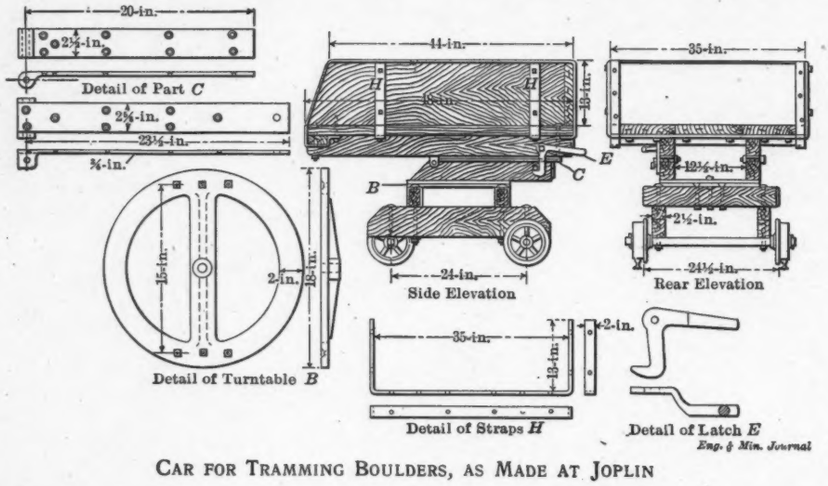
Fuse that has been subjected to actual mechanical injury, particularly to hammering or pounding or the blows of falling rock, etc., has a greatly increased rate of burning, and sometimes burns so rapidly as to be almost instantaneous in its action. The mere bending, coiling, and twisting of fuse, such as would be brought about by forcibly placing within a bore hole a length of fuse considerably greater than the depth of the bore hole, does not produce any marked change in the rate of burning, but pounding or direct abrasion of fuse greatly increases that rate. Fuse that has been injured by severe abrasion or by too great pressure from any cause should not be used in any work where adjustment of the rate of burning is desired.

As a final summary it may be stated that ordinary fuse may under some conditions burn as fast as 3 sec. per m. (1 sec. per ft.), and under other conditions it may burn as slowly as 745 sec. per m. (227 sec. per ft). The former rate is more than 200 times as fast as the latter, and each is widely removed from the normal rate of burning of similar brands of fuse. Hence, the condition and past history of any roll of fuse is an important matter, and in mining and blasting operations the safety of the miner demands that only fuse that has been carefully stored and kept from unfavorable conditions shall be used.

A Joplin Car for Boulders

By Claude T. Rice

In the mines of the zinc and lead district of southwestern Missouri the ore is hoisted in buckets, then dumped on grizzlies spaced 4½ to 6 in. apart, and the barren portion of the oversize is sorted out and taken to the dump. The headframes used are of the derrick type in which the hoist is placed at a height of 50 ft. or more from the ground. Therefore, it is not desirable to use a large car for tramming boulders as it would require a more expensive trestle on which to run the boulders away from the derrick to the boulder pile. Moreover, because the life of most of the mines is short, a cheap construction is desirable. For those reasons the boulder car used universally throughout the Joplin district is the one shown in the accompanying drawing.



Car for Tramming Boulders, as Made at Joplin

As will be seen, this is an end dump car having a turntable deck carried on a wooden truck. The wooden box of the car, which is open at the front end, is hinged to the turntable. The edges of the side boards are bound with strap iron and are reinforced by the bands *H*, passing under the body of the car and up the sides. The box is prevented from dumping by a simple hook on one side of the box. The car, as loaded in the district, holds about 1000 lb. of boulders.

In cutting a plat in an inclined shaft, if the ground is good, the first holes may be drilled while the machine is rigged for shaft-sinking; with weak ground, however, it is safer to leave the plat-cutting until after the shaft has been sunk a few feet below the proposed level. In this way, the brow of the plat can be secured and the cutting-out performed with little danger to the shaft.

Anchoring New Bolts in Old Foundation

It is sometimes necessary to change an old foundation to accommodate a new arrangement of equipment, such as the compounding of low- and high-pressure steam cylinders, to increase the power of the engine. Whenever it is necessary to set an anchor bolt in an old foundation, the difficulty may be met in one of two ways, says R. B. Dale in *Power*. In the first method a hole is drilled in the concrete slightly larger in diameter than the bolt to be used and to the proper depth. A bolt is then prepared by cutting a slot in one end lengthwise of the bolt and about six or eight inches long. This slot is then fitted with a wedge of hardened steel held in place by a pin of soft copper or other soft metal. The bolt is lowered into the hole and struck several hard blows on the upper end with a heavy hammer. This shears the soft metal pin and drives the wedge into the slot, thus enlarging the diameter on the bolt at the lower end. The bolt is then grouted into the hole and the nut is tightened to complete the work.

In the second method a hole is drilled for the bolt as before. A second hole is then drilled laterally through the side of the masonry to meet the first hole and this is enlarged sufficiently to take the standard anchor plate. The work is completed in the customary manner, precautions being taken to grout the anchor plate to a firm bearing in the old concrete. The first method is cheap and simple, although there is no certainty as to what happens in the bottom of the hole. It also has the disadvantages of the grouted bolt previously noted. The second method, while it is more troublesome and expensive, is the more reliable and should be used in preference. It is similar to the method of anchoring the mortar bolts of a stamp battery in wooden stamp blocks are used in Australia and certain districts in this country.

Details of Metallurgical Practice

Records of Experience in Ore Dressing, Cyaniding and Smelting

Calculator for the Cyanide Plant

Several articles have from time to time been published in the JOURNAL describing report forms and similar devices to aid in the control of operations at cyanide plants, but no mention has been made of the adjustable table shown in the accompanying illustration. This table has been used at the Homestake plant in South Dakota, and has been found to be of great convenience when conducting experiments involving variations in the strength of cyanide carried by the ongoing solutions.

The illustration is almost self explanatory. A simple table having been calculated, a single vertical column, equal in width to those following it, is ruled at the left of the columns containing the indicated weights of cyanide. The headings of the latter columns are entered on a detached strip of paper which is inserted in guides cut in the main sheet. By shifting this strip to left or right the headings of the various columns are shifted while the positions of the headings, relative to one another, are not changed. Provided that the columns are prepared for uniform variation of effluent strength, the column at the left may be headed "Working Strength Desired" and the table becomes adustable for any working strength within the range selected.

CALCULATING TABLE FOR BRINGING CYANIDE SOLUTIONS UP TO STRENGTH

Depth of Effluent Solution in Sump in Feet[1]	Desired Working Strength[2]	Strength of Effluent Solution in Sump to Which Cyanide Is to Be Added until the Desired Working Strength Is Obtained								
(Cut with knife along dotted lines; then insert "sliding strip" shown below the table.)										
		Pounds of Cyanide to Be Added to Solution in Sump								
1		3	6	9	12	15	18	21	24	27
2		6	12	18	24	30	36	42	48	54
3		9	18	27	36	45	54	63	72	81
4		12	24	30	48	60	72	84	96	108
5		15	30	45	60	75	90	105	120	135

[1]Figures in this table are calculated for a sump holding 30 tons per foot depth.
[2]By strength is meant the percentage of free KCN in the solutions.

Sliding Strip

Percentage of KCN in Solutions										
0.120	0.115	0.110	0.105	0.100	0.095	0.090	0.085	0.080	0.075	0.075

Crushing Frozen Concentrate

By N. L. STEWART*

I was called upon recently to investigate the merits of various kinds of crushing machinery for frozen ore and concentrate. The material to be crushed was frozen fine material containing hard lumps.

The most promising machine seemed to be a squirrel-cage type of disintegrator. However, there was some doubt as to whether it would stand the hard blows at high speed and it was feared that the frozen material might build up on the runners. Therefore, a wagonload of frozen concentrate was put through as a test.

The test was made at the plant of the Salt Lake Pressed Brick Co., near Salt Lake City, Utah. The machine used was a 44-in. Stedman's disintegrator driven by a 75-hp., alternating-current, General Electric Co., form K motor. The motor was belted to a countershaft, from which, besides the disintegrator, a short belt-conveyor was driven. The machine runners were driven at about 400 to 500 r.p.m. No clutch was used, the motor being capable of starting the machine without such a device.

The machine handled the material easily and the product was as fine as the original material before freezing. When the machine was opened at the end of the test, the runners and casing were found to be clean and free from any accumulation of frozen ore. Meter readings, taken while the equipment was running empty, indicated about 26 hp., and while crushing about 44 hp. As the belt conveyor could not have taken more than 3 hp. in either case, the machine required about 23 and 41 hp. under the two conditions.

*Care East Butte Copper Mining Co., Butte, Mont.

Fuel Used in an Oil Engine

By EARL C. CLEAVELAND*

At the Deadwood mine and mill in the Mogollon district, New Mexico, a 125-hp. De La Vergne, type F. H. oil engine has been in continuous operation for 12 months. It is operated at an altitude of 7000 ft. A Prony brake test made when the engine first arrived showed a development of 125 hp. and an oil consumption of 0.48 lb. per brake-horsepower-hour.

At this place 110 hp. is used for 12 hr. and 50 hp. for the rest of the day making 1920 hp.-hr. per day. This requires, taken from a year's run, 860 lb. of fuel oil, or 0.45 lb. per hp.-hr. Fuel oil from Kansas fields is used which costs at the railroad $1.72 per bbl. of 42 gal., and at the mine, 90 miles from the railroad, $5.46 per bbl., 13c. per gal. or 1.7c. per

*Mining engineer, Mogollon, N. M.

lb. This figures out at a cost of 0.778c. per hp.-hr. or $68.14 per hp. per year, 24-hr. service for 365 days.

The gravity of the oil is 27° Beaumé and its heating value is 19,000 B.t.u. The power cost has been reduced to less than a quarter of what it was with steam, figuring wood at $8 per cord. One engineer on each shift looks after the entire power plant.

Erecting a Steel Stack

The following method of erecting a steel boiler-stack was described by F. W. Fischer in *Power*. The stack was 127 ft. high including the masonry base, 66 in. diameter and was built to supply draft to two 300-hp. water-tube boilers. It could not be hoisted into place without being cut into sections because the boiler house was completed and hemmed in on three sides by buildings and on the other side by telephone and telegraph wires, and three lines of railroad.

The stack was shipped in three 30-ft. and one 15-ft. breeching section. The breeching was placed over the boilers; this was a comparatively easy matter. The first section was then cut into 5-ft. lengths which were set up one at a time by block, tackle and a gin pole, without much trouble. The limit of the gin pole was then reached and other means had to be provided.

It was decided to cut the other two 30-ft. sections into 5-ft. lengths and then cut those in half to enable the work to be carried on around the pole and tackle.

Starting inside the breeching, a scaffold was built; a length of 2x4-in. timber was placed vertically in the center of the stack and crosspieces of the same dimensions were cut to make a snug fit against the side of the stack. These were then spiked to the vertical timbers, making a strong scaffold. Cleats were then nailed to the vertical timber to aid the workmen in going up and down the stack.

A 12-ft. section of 2½-in. pipe was then bolted to the upper section of the stack by means of 3½-in. bolts, three rivets having been left out for the purpose. An eyebolt was placed at the upper end of the pipe, to which was fastened the block and tackle.

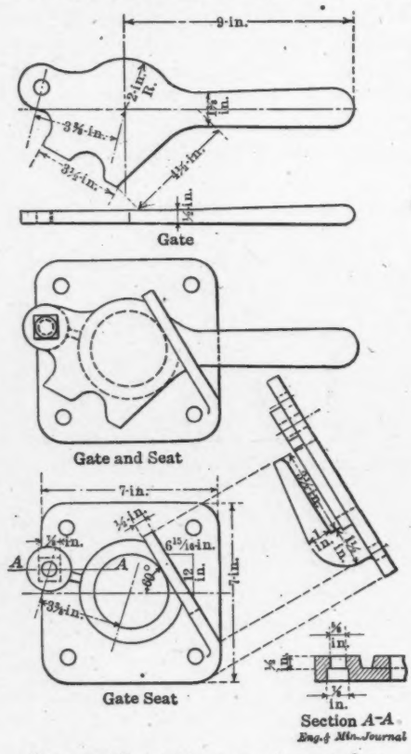
A half section of the stack was then hoisted and bolted temporarily in place until the next section was hoisted, then the two were riveted together. The pole was then raised to the section just erected and the same operation repeated, the scaffold, of course, being added to as the sections went up.

The riveter's stage was made of 1½-in. angle iron and 1x6-in. oak boards, the top of the stage being supplied with a grooved wheel which enabled the riveter to swing around the stack.

One would think, says Mr. Fischer, that this was a slow method of erecting a stack, but the whole operation took only seven working days, including the riveting, and half the time the men were nearly suffocated by the smoke coming from the other stacks at the same plant.

Tailing Gate for Jigs

In the Joplin district, jigs are fed an unclassified undersize from trommels, and a large portion of the slime goes off with the tail product from the last cell, although there is a large recovery of the finer sizes in the hutch product from the jigs. To free the tailings from this finer, richer portion, a settling compartment is provided at the tail end of the jig. This compartment is equipped with a baffle board to stop the rush of water. In some cases a hydraulic attachment of crude design is added, consisting of a 5-in. tee in which the sorting water comes in at the bottom while the underflow runs off through the branch. But whether a simple settling box or one fitted with a hydraulic attachment is used, these compartments are fitted with a gate of the general type shown in the accompanying drawing.



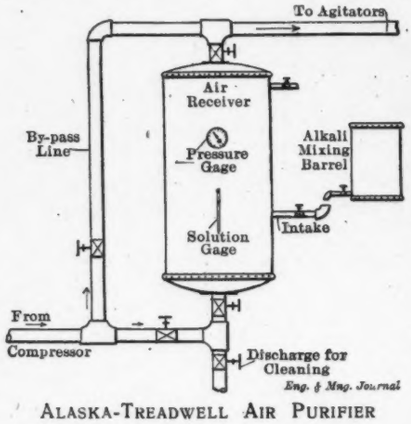
TAILING GATE USED ON JOPLIN JIGS

The gate consists of a cast-iron plate that is bolted to the wooden frame of the jig. In it is a hole 3 in. in diameter, while projecting from its side is a brace to support the gate proper which is fastened to the seat casting by a bolt. The gate piece is cast with a handle to permit of easy adjustment, while in the bottom face is a small semicircular recess. This permits the opening to be contracted as much as desired, and it is possible, in case of stoppage, while using a small discharge opening, to start the flow again by simply opening the gate valve to its full extent. It is by the size of the draw-off opening that the grade of the overflow is regulated, and it is on that account that the valve must permit close adjustment, while, because of the fact that the bulk of the mill feed goes through it, it must be cheap and easily replaceable. The gate herein described seems to fill these requirements.

Purifying Air for Agitating Pulp

At a number of cyanide plants in the United States, the compressed air that is to be used for aërating the sand or slime, or in agitating the pulp, is purified by filtration before use. Several types of filters are used; at the Homestake plants the air is passed through a filter-press made up of several cells similar in all respects to the cells of the Merrill presses used in the treatment of slime. At the Alaska-Treadwell concentrate-cyanide plant, the apparatus described by W. P. Lass[1] and shown in the accompanying illustration, is used.

Cylinder oil or the products of its combustion or decomposition, which are introduced into the air in the cylinders of the compressors, are the impurities that should be removed as completely as possible before the air is used for agitating. The Homestake presses do this effectively by the filter cloths retaining the oil and other solid impurities contained in the air.



ALASKA-TREADWELL AIR PURIFIER

The apparatus herein illustrated has a further advantage in that carbonic acid is also removed by caustic soda or milk of lime. The removal of this acid is accompanied by a decrease in the consumption of cyanide, for it is a well-known fact that carbonic acid decomposes potassium and sodium cyanides, and even in the presence of an abundance of protective alkali some decomposition by this acid may take place.

[1]Bull., A. I. M. E., February, 1912.

Construction of Argentine Tram

By C. A. Tupper*

The lack of reliable maps necessitated a preliminary topographical survey. The proposed route was indicated on continuous photographs of the country between the terminals, Chilecito and Upulungos. The structural-iron work was made and assembled in Germany, then knocked down and shipped. The construction work occupied 11 months, about 1200 men being employed.

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The construction of the aerial tramway, now operated by the government of the Argentine Republic from Chilecito, in the province of Rioja, to the Famatina group of mines, 21½ miles distant, with an elevation of 11,570 ft. above the plain, was attended by features of unusual interest.

No Reliable Maps Available

There were no reliable maps of the region, which is studded with precipitous slopes and lofty peaks; it was therefore necessary to complete a thorough topographical survey before the route to be followed by the aerial line could be even approximately determined. This was accordingly undertaken by an engineering commission appointed by the Argentine government especially for the purpose. Then the route apparently most suitable was roughly sketched out.

In general it followed, at the beginning, the bed of a mountain stream, and ran for almost exactly half the distance, or over 10 miles, in a practically straight line. Beyond this point it was necessary to make four turns, only the last of which, however, was at anything like a sharp angle. The plan and profile are shown in the accompanying engraving.

THE PROPOSED ROUTE OF THE ARGENTINE TRAM WAS SKETCHED ON CONTINUOUS PHOTOGRAPHS, AS SHOWN

Subsequently, cameras were set up at frequent intervals along the proposed route in such a manner as to secure, when the resulting photographs were placed end to end, a continuous bird's-eye view of the country at close range, with every physical feature clearly outlined. Then the line was drawn in on the photographic prints, as shown on greatly reduced scale in the accompanying halftones, one roll of which was sent to the engineers of the tramway designers and constructors, Adolf Bleichert & Co., Leipzig-Gohlis, Germany, another filed with the proper department of the government at Buenos Aires and a third retained for use in the field. The prints also showed the places suitable for stations, of which 10 were found to be desirable, inclusive of the two terminals.

Following the preliminary survey, the government engineers made a general determination of altitudes and distances, employing for this purpose the instrument, used largely by European engineers, known as the "tachometer," literally "rapid measurer," a name which has also been appropriated by manufacturers of revolution indicators for high-speed machinery. This has on its telescope a level, a vertical arc or circle and stadia wires. It is adapted to the rapid determination of points in a survey, since with it the three coordinates of a point in space can be measured, viz: The angular coordinates of azimuth and altitude and the radius vector or distance.

For the actual construction work, this method was not considered sufficiently accurate; careful detailed measurements of altitudes, contours and air-line distances were accordingly made for the entire route, this work being carried out by a supervising engineer in the employ of the tramway builders, with the aid of government engineers. For aerial line construction accurate measurements are just as essential as in railroad surveys, or, in fact, more so; for discrepancies in ground contours, elevations, etc., and the consequent furnishing, for erection, of supports that are too high or too low are apt to cause serious difficulties in operation. In such a case, for example, when the line is heavily loaded, the carrying or track cable may tear itself loose from the shoe holding it down. Therefore the ground contours for the Chilecito tramway and all other measurements were accurately secured, the curves of the track cables plotted for safe working tension and the heights of the supports decided upon. In actual construction the cables were stretched to a somewhat lower tension, to reduce the lifting strains. Not content with the precautions above enumerated, the engineers of Bleichert & Co. made a final confirmatory survey, which began with the laying of the foundations for the lower terminal station and first supporting towers and preceded, from point to point, the placing of all foundations.

Cart and Mule Road Made First

Before any labor on the tramway itself was begun, a start was made towards opening up communication through the mountains from Chilecito to the proposed upper terminal, at Upulungos, by the cutting of a road traversable with carts for a part of the distance and by mules for the remainder. This followed as nearly as possible a course coinciding with that to be taken by the tramway, although subject to innumerable windings; side paths were cut to various construction points. In all there was over 30 miles of the main path and about 38 miles of side paths, much of which had to be built under the most difficult conditions.

As soon as the road-making was sufficiently advanced to permit work on the tramway itself, operations for this purpose were inaugurated. A great deal of cutting was necessary along mountain slopes to avoid deviation of the line and numerous levels were required for the foundations of the stations and towers. As much of the mountain-slope formation consisted of granite and quartz, considerable blasting was necessary. At the seventh station out from

Chilecito it took 70 drillings and the simultaneous firing of as many dynamite charges to clear the space needed. In another part of the route a tunnel 492 ft. long had to be bored through one of the peaks to reduce the grade and overcome other construction difficulties at that point.

While the work proceeded provision had to be made for construction camps and everything pertaining to them, as well as for mechanical facilities with which to carry on the erection of the tramway without interruption. A large storage and assembling plant was constructed at Chilecito from which all supplies, structural iron, cables, tools, provisions, etc., were regularly forwarded as required.

When the line got beyond the point where carts could be used, all transportation had to be undertaken with mules and donkeys, of which nearly 900, including requisitions from the government artillery service, were in use at the last. The structural material was sent from Germany in sections small enough to be carried in this manner. The cables could not safely be divided into lengths of less than 200 to 300 m. (665-982 ft.) and some of the pieces exceeded 2 tons in weight; hence it was necessary to unroll them and have the cable carried on the shoulders of native porters, from about 60 to several hundred of whom were required, according to the extent of the burden and the grade and difficulties of the ascent.

In pushing forward an aerial line there are not, of course, the advantages of railway building, where the construction train advances rod by rod as the track is laid. As soon as cables have been stretched from one station to another, however, and the necessary sheaves installed, that section can be put in operation for the bringing up of material. Cables for the Chilecito tramway were transported over finished stretches, being hung in coils from carriages one behind another in close proximity, as shown in the accompanying halftone.

Screw Bolts Used Instead of Rivets

All of the structural shapes and columns were fabricated in Germany, the stations, towers, etc., being put together complete with screw bolts, each part carefully marked to indicate its position and then knocked down for shipment. For the most part the erection was also with screw bolts, little riveting being done.

The intermediate stations were at points where the division of the line could be made to the best advantage, with due allowance for stresses in the traction cables. These stations are all of low, simple construction, not more than 16 to 20 ft. above their foundations. The use of scaffolding could therefore be almost entirely dispensed with; an important consideration in a district where timber is scarce and expensive to procure.

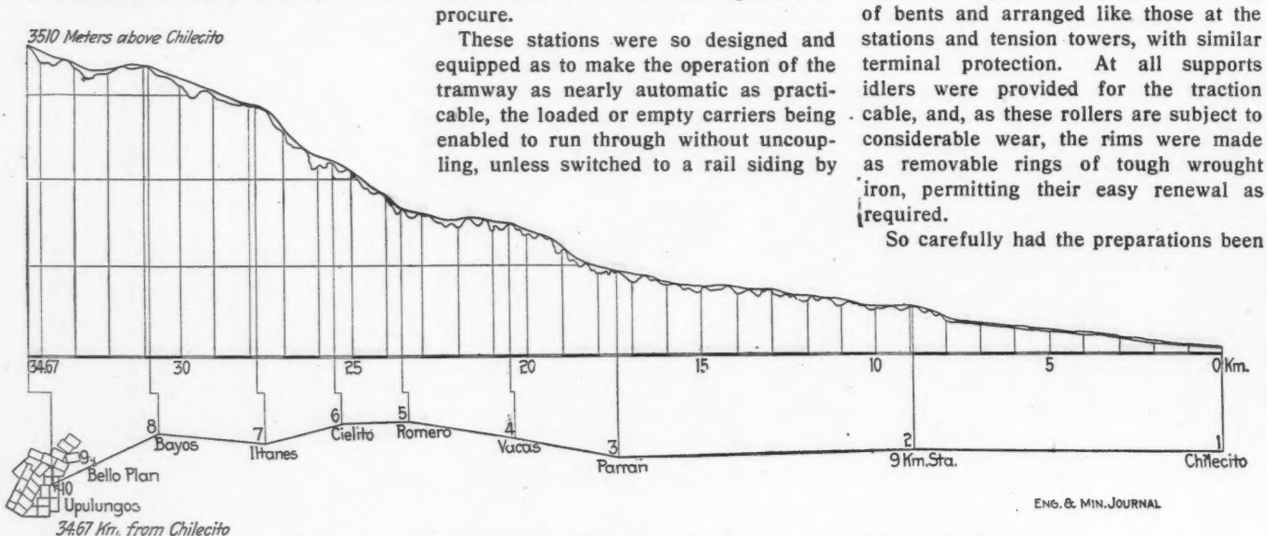
These stations were so designed and equipped as to make the operation of the tramway as nearly automatic as practicable, the loaded or empty carriers being enabled to run through without uncoupling, unless switched to a rail siding by the attendant. Through each station the traction cable was replaced by overhead rails. At the points of entry and departure these were made to terminate in special "shoes" or saddles so arranged that the transition of the carriages to and from the cables would be without jar. These shoes were provided with hinged steel hoods that cover the cable on both sides of the saddle and protect it from excessive wear.

Between stations special towers were erected wherever it was necessary to apply tension to the carrying cables which constitute the carriage track, such cables being rigidly anchored or counterweighted, according to conditions. Where the cables were parted at these towers the ends were joined by rail tracks, with connections similar to those at the stations, allowing the carriages with their suspended loads to pass through smoothly without interruption. All cable sections were joined with what is known as the Bleichert patent coupling. The tension apparatus installed included structural box frames with weights of concrete suspended over sheaves and rollers by flat-wire cables of tough steel.

The smaller line supports, up to 32 ft. in height, were bolted and riveted on the ground, then raised and secured to the masonry and concrete foundations. Higher supports, however, up to towers 135 ft. high, including the tension and anchoring structures above mentioned, were erected and riveted by stages, each section forming the base for the one above, until near the top, when the remaining sections were put together at ground level, raised and bolted to the substructure, as indicated in the accompanying illustration.

In one place along the route, where it was desired to clear a mountain peak at a vertical angle without increasing the elevation of the line, the track cables were overhung by rails carried on a series of bents and arranged like those at the stations and tension towers, with similar terminal protection. At all supports idlers were provided for the traction cable, and, as these rollers are subject to considerable wear, the rims were made as removable rings of tough wrought iron, permitting their easy renewal as required.

So carefully had the preparations been made that the various structures and pieces of operating mechanism all went together without any changes, beyond such minor details as the occasional redrilling of a hole. There were no parts missing and no accidents, except such mishaps as were due to blasting and other unavoidable occurrences of the kind known in contracts and insurance policies as "the acts of God." Among the last named were, of course, rain and snow storms and floods, including a cloudburst which carried material many miles down the mountain slopes; but, even in this case, it was nearly all recovered without material damage, the deficiency being supplied from the spares in store at Chilecito. So far as possible, all parts had been made interchangeable, thus greatly facilitating replacements and reducing the stock to be carried. Each section of a supporting tower, for ex-



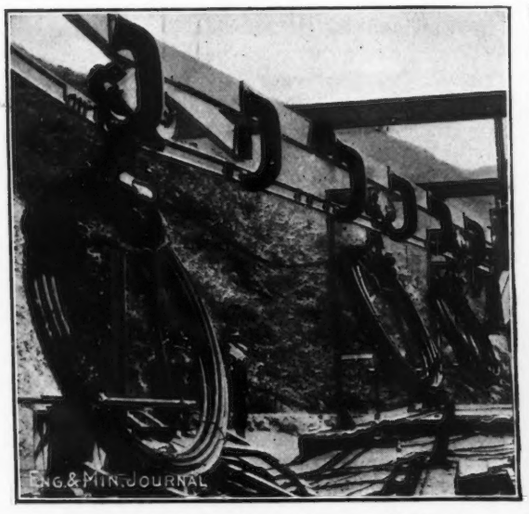
Plan and Profile of the Country Traversed by the Argentine Tram

ample, was identical with that of any structure for the same purpose in the part having the same base area, regardless of the total height.

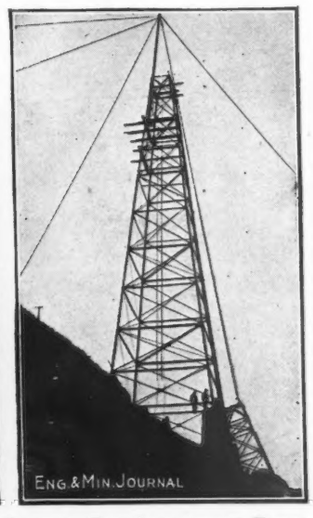
BUILT IN ELEVEN MONTHS

Seven months after the construction of the tramway itself was started, more than two-thirds of the line was in operation, and four months later it had been completed. During that period the working force reached at times nearly 1200 men. On the lower end a 10- or 12-hr. shift was employed daily, except as saints' or feast days interfered; but, as the line climbed the mountains, it was necessary to curtail the working day. In the upper reaches the temperature was only endurable for labor between about 8 a.m. and 4 p.m. With the going down of the sun in that region a cold, cutting wind ordinarily sets in, rendering it dangerous to remain outside of shelter.

Another fact to be taken into consideration was the rarity of the atmosphere at the high altitudes and its effect upon the vitality of the laborers; so that the progress made towards the end was remarkable under the circumstances. At the camps the best of provision for food, sanitation and sleeping quarters was made. In the lower region tents sufficed; but for the upper stone huts had to be built to secure the necessary shelter and warmth. The laborers were a motley crew of natives, including Indians, also Spanish, Portuguese and Italian immigrants. The Italians, particularly those from Piedmont, made the most efficient workmen. Skilled mechanics and structural workers had to be brought from Europe, with their foremen and a staff of superintendents and engineers.



BRINGING UP CABLE OVER FINISHED SECTION.



RAISING TOP SECTION OF TOWER

The Miami Copper Co. has declared its first dividend of 50c. per share. This dividend is for the quarter ended Mar. 31, 1912, and is payable May 15, to stockholders of record on May 1, 1912.

Superficial Examination of Ore Deposits

In speaking of the superficial appearance of ore deposits, George J. Bancroft (*Proc.* Colo. Sci. Soc., vol. 10, p. 39) says that the examination of a prospect calls for more skill in all directions than the examination of a developed mine, as the engineer is often called upon to decide the future development, when there is nothing in sight but a 10-ft. hole with ore in the bottom.

When the immediate surroundings of an outcrop give no indication of its identity, it will often be found instructive to walk around a prospect at a radius of a mile or so. The walls of the cañons or gulches will often give a clue to the structure. A bold outcrop is often a remnant of an overlying stratum, and the local dip of the formation can sometimes be picked up at its base. Or the outcrop may be an intrusion, or a false scarp, but in any event it is worth knowing about. Of course neighboring mines, if they exist, should be visited and studied, if the owners will permit.

The most perplexing prospects are those which occur in a flat or gently rolling country. This class embraces a good many commercial mines. Where acid waters are prevalent, the rocks are softened, and the hills take on a soft rolling contour, while nearby mountains, which contain no ore deposits, may be sharp and rugged. In such cases it will often be found useful to climb a neighboring hill, and look down on, or over at, the hill of the prospect. At first no structural indications may be apparent, but it pays to go slowly in these cases. As the shadows change the structural details may appear. Sometimes a certain tree or bush will have a fondness for a certain formation, and a half hour spent in studying the verdure will often reveal more of the hidden rock structure, than days of digging would do. Thus a vein or porous stratum is apt to be a waterway, and its outcrop is often marked by water-loving shrubs, bushes, or by green grass. A slight shading in the soil may also become distinct under changing light or cloud shadows.

Deep-rooted trees are killed by acid waters, hence a hill barren of trees, or containing many stunted trees, in a forested country, should be an object of interest to a mining man. The outline of large sulphide deposits can sometimes be traced by the boundary of injured timber. As a rule orebodies do not make coarse pieces of float, so study the finer particles of the soil. A common gold pan will be found useful in doing this; while the local prospector will probably run down any clues to free gold, he will pay but little attention to the black sand, which should be carefully attended to. Having ascertained the dip of a fissure vein one should imagine how a plane surface having that dip would cut the contour of the particular locality. Many a prospector has lost valuable property by failing to realize the rudiments of conic sections. If a vein dips into a hill, and the outcrop crosses a gulch, the outcrop will extend up that gulch in a V shape, the angularity depending on the dip.

A simple plan is to take a book or a piece of board, and hold it parallel in dip and strike with the vein, and sight across it to the hill or gulch where the continuation is sought. In contact bodies between eruptive and noneruptive rock, it not infrequently happens that all the ore will make on the contact between the eruptive and a certain stratum of the surrounding rock. A close study of the local conditions should be made, as it will probably save much exploration work.

An impregnation deposit in a crystalline rock looks, as a rule, like a narrow vein with a reddish or brown discoloration of the rock on both sides. As most veins are accompanied by bands of discolored rock, there seems to be no way to be sure except to assay the discolored country rock alongside an orebody. Although the valuable portion of a vein is generally confined within its walls, nevertheless it is the duty of the examining engineer to keep his eyes open for impregnation deposits.

It usually requires but little work to prove that a deposit is not a vein or a contact, then of course, it is either a pocket, or a pipe, or a chimney. Unfortunately the true pipes, or chimneys are rare, while isolated pockets are many. There is no certain way to prove whether the prospect is one or the other, except to sink on it, but sometimes one can find sinter, or oynx, or other evidence of geyser action. Where such evidences are found it is fairly safe to sink in case the ore is of value.

Solution and Its Importance

By Harry C. Jones*

Solution incomparably the most important manifestation of matter; nine varieties of solution are considered. Optical activity, surface tension, capillarity and osmotic pressure some of the interesting functions of solutions.

*Professor of Physical Chemistry, Johns Hopkins University, Baltimore, Md.

We have frequently spoken of the term solution as used in the modern or broad sense. We had become accustomed to think of solution as chiefly, if not exclusively, the solution of a solid in water. This is a limited use of the term.

Nine Kinds of Solution

We know matter in three states of aggregation, and matter in every state dissolves in matter in the same and in every other state of aggregation. There are, therefore, nine kinds of solutions and we have well defined examples of them all. They are:

(1) Gas in gas; (2) liquid in gas; (3) solid in gas; (4) gas in liquid; (5) liquid in liquid; (6) solid in liquid; (7) gas in solid; (8) liquid in solid, (9) solid in solid.

A mixture of any two gases that do not act chemically upon one another is an example of the first type of solution. Such mixtures are as typical solutions as mixtures of liquids and liquids or solids and liquids; in terms of the definition of solution universally accepted, as a "homogeneous mixture, the constituents of which can not be separated mechanically."

An example of the second type of solution is water or any other liquid throwing vapor into the gas above it. It may be objected that this is not a solution of a liquid in a gas, since the liquid appears to pass first into vapor and this then dissolves in the gas. To offset this objection it is only necessary to remember that when cane sugar dissolves in water the cane sugar in the aqueous solution could scarcely be regarded as being in the solid state. Similarly, when a solid like iodine throws vapor into the superincumbent gas, we have a solution of a solid in a gas.

When we turn to solutions in liquids as solvents the number of examples is almost limitless. Practically all gases dissolve in all liquids, and when the gas does not act chemically upon the liquid we have a true solution of the former in the latter.

Examples of (5) and (6) are too well known even to mention. There are also abundant examples of solutions of gases in solids. Charcoal has long been known to take up large quantities of carbon dioxide; and many liquids are also taken up by solids. Case (9) or solutions of solids in solids, is especially interesting, not simply on account of the large number of examples known, but on account of their important properties. These will be discussed at some length in the proper place. If the meaning of this section is clearly grasped, the broad sense of the term solution will be understood.

Solubility

We have all degrees of solubility represented in these various different types of solutions. All gases dissolve in all other gases, upon which they do not act chemically, to an unlimited extent—we have unlimited solubility. Liquids and solids dissolve in gases to only a limited extent. When we come to solutions in liquids as the solvents we have all degrees of solubility represented. Some liquids are scarcely miscible at all with others, while other pairs of liquids mix in all proportions; and we have all intermediate degrees of solubility. There is one case in connection with liquid solutions that is very interesting, and that is where the liquids, at ordinary temperatures, mix to only a limited extent—where there is only limited solubility.

Solubility Influenced by Temperature

This case is interesting because of the change that it undergoes with change in temperature, and because of a misunderstanding of a simple matter, to which it has led. Given two liquids that at ordinary temperatures mix, or dissolve one another to only a limited extent. If such a pair of liquids is placed in a glass tube, sealed up and shaken, we will have two solutions—that of A in B and that of B in A. These two solutions will be separated by a well defined meniscus, and we will have in the tube two well defined systems.

Now place the tube in a furnace and raise the temperature. There is always a temperature where the meniscus between these two systems will disappear—where the two systems will become one. When this is the case this class of liquids which dissolved one another to only a limited extent, passes over into the class where there is unlimited solubility. Limited solubility among liquids is then but a special case of unlimited solubility—its being a function of temperature only.

This raises the question as to whether there is not a temperature at which liquids, which at ordinary temperatures mix in all proportions, would dissolve one another to only a limited extent? Theoretically, there is a temperature at which every pair of such liquids would dissolve one another to only a limited extent—where this class of liquids would pass over into the class with limited solubility. Whether this temperature can be realized experimentally for any pair of liquids, depends upon whether it lies above or below the freezing points of the liquids in question.

An interesting misinterpretation has sometimes been given to such systems of liquids which mix to only a limited extent. For example, it has been said that salicylic acid melts under boiling water, and yet dry salicylic acid does not melt until a temperature of 156° C. is reached.

This is a remarkable contradiction in statements, especially when we consider what a melting point is. It is simply the temperature of equilibrium between the liquid and solid phases of a substance. This definition, it will be noted, does not raise any question as to what the nature of the medium is which surrounds the substance; and yet it is stated that the nature of the medium—air in one case and water in the other—changes the melting-point of this substance more than fifty degrees.

This statement, of course, ignores the most elementary physical principles, and is absurd. The oily liquid which appears under the hot water when more salicylic acid is added to the water than will dissolve in it, is not molten salicylic acid at all, but is a solution of water in salicylic acid; the supernatant liquid being a solution of salicylic acid in water. The system salicylic acid and water fulfills the condition, near the boiling-point of water, of two liquids which, at that temperature, mix to only a limited extent—the salicylic acid solution of water being a liquid at that temperature.

Vapor Tension of Solutions

It has already been stated that the vapor tension of a solution is, in general, less than that of the pure solvent. This is true when the dissolved substance does not have much vapor tension of its own. Ether dissolved in water gives a solution whose vapor tension is greater than that of pure water. When the dissolved substance boils about 130° higher than the solvent, then it always lowers the vapor tension of the solvent in which it is dissolved. This is, of course, the same thing as to say that the dissolved substance raises the boiling point of the solvent.

There is one case of the vapor tension of mixtures of liquids that is especially interesting, because its misunderstanding has led to a serious error. If we mix two liquids like ordinary alcohol and water, and raise the temperature of the mixture, the vapor tension will increase with the temperature. If we plot the curve whose ordinates are vapor tensions and whose abscissas are percentages of alcohol, we would find that for almost any temperature the curve was approximately a straight line. This means that if such a mixture were boiled, more of the alcohol would come over first and more of the water later as the temperature is raised.

This principle is utilized in the fractional separation of water and alcohol by boiling the mixture in a fractionating still. More of the alcohol comes over at first, and more of the water remains behind. By repeating this process a number of times it is possible to obtain fairly pure alcohol from its aqueous solution.

Constant Boiling Mixtures

If, on the other hand, the vapor-tension curve of a mixture of two solids instead of approaching a straight line has a well-defined maximum in it, then a very different result is obtained when such a mixture is boiled. The maximum in the vapor-tension curve for a certain definite mixture of the two liquids, means that this mixture will boil lower than any other mixture of these two liquids—maximum vapor tension being of course synonymous with minimum boiling point.

If we start with any mixture of these two liquids and boil the mixture, that constituent will come over first, which by so doing will leave behind the mixture with the maximum vapor tension. When this mixture with a maximum vapor tension is reached, it will come over and will have a constant composition, if the mixture is boiled under a constant superincumbent pressure.

Such mixtures have frequently been looked upon as definite chemical compounds, simply because they had, under given conditions of superincumbent pressure a definite composition. This is all an error. Constant composition is a necessary, but far from a sufficient condition to have chemical union, as we shall now see.

Take any mixture of hydrochloric acid and water and boil the mixture. Water or hydrochloric acid will predominate in the first part of the distillate, depending on the composition of the original mixture. That constituent will come over at first in the larger quantity which, by so doing will leave the residue of the composition $HCl.8H_2O$.

When this composition is reached the system $HCl.8H_2O$ will distil over, and of approximately constant composition. This was regarded for a long time as a definite compound of hydrochloric acid and water—a definite hydrate, and it was so stated in the text and reference books on chemistry.

It was, however, shown that if the superincumbent pressure was changed, the composition of the mixture that came over was likewise changed. If the pressure was lowered the mixture contained more hydrochloric acid than corresponded to the composition named above; yet for any definite superincumbent pressure, there always came over a mixture of perfectly definite composition.

The fact, however, that you change the composition of the mixture through comparatively wide ranges, simply by changing the pressure under which the boiling took place, showed that these mixtures of constant composition were *not* chemical compounds. They are simply those mixtures of the two liquids in question that have a greater vapor tension, under the conditions, than any other mixtures, and, therefore, a lower boiling point. There are comparatively large numbers of such systems with a maximum in the vapor-tension curve, and the error of supposing that there were chemical compounds was, consequently, wide-spread.

The vapor-tension curve of the mixture of two liquids may, instead of having a maximum, have a minimum. That mixture which has the minimum vapor tension would, of course, have the highest boiling point.

If any mixture of the pair of liquids with a minimum in the vapor tension curve were boiled, that constituent would predominate in the first part of the distillate whose absence from the original mixture was in part necessary to give that mixture with the lowest vapor tension or highest boiling point.

When such a mixture is boiled the residue that remains behind in the flask will tend more and more to the composition having the minimum vapor tension, and by repeating the distillation several times, it is possible to obtain a residue with approximately constant composition.

If, however, the pressure under which such a mixture is boiled, is changed, the composition of the residue will change. This shows that such residues are no more chemical compounds than the distillates of constant composition which came over when the vapor tension curve contained a maximum point.

Equilibrium of Vapor Tension

One other point before leaving the subject of the vapor tensions of liquids and solutions. We are accustomed to say that at any given temperature, a liquid or solution has a definite vapor pressure. Just what does this mean? How does a liquid produce a vapor pressure above it. Obviously, by throwing molecules of itself into the superincumbent space. The liquid continues to do this until the vapor above the liquid acquires a certain concentration—until a certain vapor pressure is reached. Then what happens? Does the liquid then cease to throw off vapor? Certainly not. If the liquid ever throws off vapor at a given temperature it will always continue to do so. Then how is a certain definite vapor pressure reached at a given temperature? Why does not a liquid produce above itself an infinite vapor pressure? in a word, how is equilibrium established?

The liquid throws off molecules of vapor and always continues to do so. The vapor, on the other hand, is always condensing, reforming the liquid. The more concentrated the vapor—the greater the pressure of the vapor—the more rapidly is it condensing to the other liquid form.

When equilibrium is reached, i. e. when the vapor has acquired its normal pressure at the temperature in question, it means simply that the vapor is condensing just as rapidly as it is being formed. The equilibrium here, as in the case of a typical chemical reaction discussed in the first chapter, is not statical as was supposed for a long time, but is dynamical. The two opposite processes, here the passage of the liquid into the vapor state and the condensation of the vapor back again into liquid, have acquired equal velocities.

This is in keeping with the way in which today we look upon equilibrium in general. Hitherto it was regarded as a statical condition, but now it is known to be dynamical; and the difference is one not merely of words, but is fundamental to our real understanding of both physical and chemical processes, as a moment's thought will show.

We shall probably see other examples illustrating the dynamical nature of equilibrium.

Optical Activity

It is well known that certain pure liquids, and solutions of certain solids have the property of rotating or twisting a beam of polarised light. In polarised light the vibrations in the ether are all in the same plane. These substances turn the plane of polarisation, as can readily be seen and measured by means of the polariscope. Such substances are termed optically active.

This property at first sight might seem to be no more important than any other property of liquids or solutions. Such is, however, far from being the case.

The first to throw any really scientific light on the meaning of this property was another of the greatest men of science who has ever lived—Pasteur. Ra-

cemic acid, which is an organic acid isomeric with ordinary tartaric acid, forms a beautiful crystalline double salt with sodium and ammonium. The sodium-ammonium racemate forms two kinds of crystals. On one of these kinds we have what are called right-handed planes, and on the other the left-handed planes. By means of these planes the crystals can be separated into two classes, the so-called right-handed crystals and the so-called left-handed crystals.

When the right-handed crystals were dissolved in water their solution rotated the plane of polarisation to the right, and the solution of the left-handed crystals rotated the plane of polarisation to the left. These crystals were obviously unsymmetrical, since some contained only right-handed and others only left-handed faces. Pasteur recognized this and pointed it out clearly.

He then obtained the acid from the right-handed crystals of the salt, and found that it was identical with the dextro-tartaric acid, and the acid from the left-handed crystals was laevo-racemic acid, rotating the plane of polarisation just as much to the left as dextro-tartaric acid rotated it to the right.

He then separated from ordinary racemic acid, which is optically neutral, two optically active constituents; but he went further than this. He brought these two optically active constituents together and reformed optically neutral racemic acid.

Asymmetry in Crystalline Structure Necessary for Optical Activity

From his work as a whole, Pasteur was able to see not only that asymmetry in crystalline structure was necessary for optical activity, but that to explain the phenomenon we must go much more deeply into the matter. Light is a vibration of the ether. If matter affects light it must do it by means of something which affects the ether and, consequently, vibrations in the ether. The smallest constituents of matter that were known in the time of Pasteur were the atoms. These were united and formed the molecules. Pasteur, with that insight and foresight which are characteristic of a great genius, saw that in order to explain optical activity, the molecule itself must be asymmetric. A symmetrical molecule could not twist a beam of polarized light, since what one side of a symmetrical molecule would do, the other side would just undo, and *vice versa.*

Said Pasteur "there must be an asymmetric grouping of the atoms in the molecule" in order that a substance should be optically active. He went a little farther than this and pointed out that the asymmetry in question "must be that of an object and its image in a mirror," but he was not able to give any conception of the geometrical configuration of the molecule.

Origin of Stereochemistry

When we reflect on what our conception of a molecule is, its size and other properties, it seems next to impossible to solve the problem of the geometry of even the simplest molecule; and yet this has been done, and done in such a way as to leave no reasonable doubt of the result. To bring this out, was the special object of taking up the property of optical activity in the present connection.

It has been the history of chemistry that whenever any fundamental problem was to be solved, resort had to be had to physical methods. There is not a single exception to this statement. Here we are dealing with the shape of molecules—a fundamental problem of chemistry, and we must resort to "optical activity," or the action of substances on light to solve it.

Further, when any fundamental problem comes up for solution, there are only a few men at any one time who are capable of coping with it. At this time Van't Hoff was only about 22 years old, and his first great contribution to science was the solution of the problem now under discussion.

The question then is, what is the cause of certain substances rotating the plane of polarized light? Pasteur showed that it was due to some kind of asymmetry. The question is what kind? And this involves the question of geometrical shapes of the molecules themselves.

Take the simplest compound of carbon and hydrogen, methane, which contains one atom of carbon and four atoms of hydrogen—CH_4. It had been shown that the four hydrogen atoms all bear exactly the same relation to the carbon atom in this molecule. This was done by purely chemical methods. One hydrogen atom was replaced by chlorine and the properties of the monochlormethane (CH_3Cl) thus formed, were studied. This chlorine was replaced by hydroxyl, another hydrogen replaced by chlorine, and the hydroxyl then replaced by hydrogen. This insured the production of a monochlormethane in which the replaced hydrogen atom was not the same as in the first compound, but the properties of this compound, when studied, were found identical with those of the first. In the same general way all four of the hydrogen atoms of methane were removed and replaced, one at a time, by chlorine, and the four monochlormethanes thus formed were all found to have identical properties, i. e., to be the same substance; showing that all four of the hydrogen atoms in methane bear exactly the same relation to the molecule.

Geometry of Methane

Given this fact, Van't Hoff saw clearly that the geometry of methane follows, of mathematical necessity. Given a central point, what is the necesary geometrical configuration of four things arranged symmetrically about it in three dimensions in space? Necessarily the regular tetrahedron. The shape of the molecule of methane is, then, the regular tetrahedron; and this was the first time (1874) that the geometrical configuration in space of any molecule had ever been worked out.

How does this solve the problem of optical activity?

If the carbon atom is combined with four atoms or groups of the same kind, then we have the arrangement of the regular tetrahedron. If, however, the carbon atom is combined with four different atoms or groups, then we have asymmetry; the center of gravity of such a system not being at the geometrical center of the tetrahedron. If this is the explanation of optical activity, then only those compounds could be optically active which contain a so called asymmetric carbon atom, i. e. a carbon atom in combination with four different atoms or groups. This was a crucial test, being a necessary consequence of the theory. When Landolt's comprehensive book "Optische Drehungsvermögen" was published in the last edition, there were about seven hundred optically active compounds of carbon known, and there was not a single discordant substance among them. Every one of them contained a carbon atom in combination with four different atoms or groups. Thus the theory was beautifully substantiated by the facts.

While discussing this work of Van't Hoff on the tetrahedral carbon atom, so called, in connection with the subject of optical activity, something should be said in reference to its bearing upon chemistry in general, and especially upon the chemistry of carbon.

Importance of Stereochemistry

This suggestion of Van't Hoff is connection with carbon compounds, was the beginning of chemistry in three dimensions, of stereochemistry as it is called. It is difficult to over estimate the influence of this suggestion, especially upon organic chemistry. So great, indeed, has this become that practically all of the best organic chemistry for the last 30 years has centered around it. The tetrahedral carbon atom "has been the philosophy or guiding thought in carbon chemistry for the last quarter of a century, almost to the exclusion of every other generalization."

And stereochemistry has by no means been limited to carbon and its compounds. We have already made a begin-

ning in the stereochemistry of oxygen, nitrogen, sulphur, cobalt, and several other elements. The chemistry of the near future will largely be the chemistry in three dimensional space, and this was all opened up by a Dutch boy of twenty-two.

Surface Tension

When a bit of mercury is thrown upon a smooth wooden surface, it does not spread out and cover the entire surface in the form of a layer of infinitesimal thickness, but collects in the form of droplets, which, except on their under surfaces, are approximately spherical. The question is why is this?

It is due to the presence of a force which exists at the surfaces of liquids, which acts so as to give the liquid the least free surface—so as to draw the liquid into that geometrical form which has the largest mass for the given surface, or the smallest surface for any given mass. Hence, the spherical form of the mercury in the case cited above. This force which exists at the surfaces of liquids is known as surface tension.

A large number of methods, and several good ones, have been devised for measuring the magnitude of this force. The best known is the capillary tube method. The liquid is allowed to rise in a glass capillary tube, and the height to which it rises determined. We must also know the diameter of the tube, the specific gravity of the liquid and the gravitational constant in order to calculate the surface tension. These values are all easily determinable, so that it is quite possible to measure surface tension with reasonable accuracy by this method.

The question is why is the surface tension of liquids even referred to in the present connection?

When we were discussing the laws of gases as applied to the osmotic pressure of solutions, it was pointed out that while we have a very plausible theory as to the cause of gas pressure, we do not know even today, what is the cause of osmatic pressure.

A large number of suggestions have been put forward to account for osmotic phenomena and none of these seem, on their face, to be plausible. Take this one. Given a semi-permeable membrance below which is pure water and above it a solution of cane sugar. The water molecules strike the membrane from below and pass through, the water molecules from above are, in part, prevented from striking the membrane, due to the increasing influence of the sugar molecules dissolved in the water. More water molecules strike the membrane from below than from above, consequently more water passes into the solution than passes out in a given time; and we have what we term osmotic pressure.

This plausible suggestion on careful analysis will be seen to explain nothing. The membrane is transparent to water. Therefore, with respect to water it is just as if it were not present. The sugar molecules above the membrane will, therefore, throw down through the membrane just as many molecules of water as it will screen off from striking the membrane from above. This explanation could, therefore, never account for a thousandth of a millimeter of osmotic pressure.

Surface Tension and Osmotic Pressure

And the same fate has befallen about every other explanation of osmotic pressure that has thus far been prepared. We are, however, today pretty certain of this—that osmotic pressure is fundamentally connected with surface tension, which manifests itself in the fine capillaries of the semi-permeable membrane, and whenever the phenomenon of osmosis is really explained, we shall have to take into account capillarity and its cause—surface tension. This is one of the reasons for discussing surface tension in the present connection. Surface tension can, however, be discussed among the physical properties of liquids in general, without any apology, on account of its own inherent importance. We are coming more and more to realize that it plays a prominent part in living matter. It appears in many relations to be fundamentally connected with life, and what these relations are is just beginning to be discovered.

Further, surface tension is at the foundation of all precipitation in chemistry, as will come out when we discuss colloidal solutions and colloidal suspensions.

Again, by means of the surface tension of liquids we are enabled to determine their molecular weights in the pure, homogeneous condition. The importance of this method will be obvious if it is pointed out that it is the only reliable method even today of determining the molecular complexity of a single substance in the liquid condition. It is the only method which enables us to answer the question. What is water? At ordinary temperatures it is not H_2O, but $(H_2O)_4$.[1]

Dielectric Constants

What is meant by the dielectric constant of a liquid? It is difficult to give a physical interpretation of it. Its meaning is most clearly understood to myself, from its place in Coulomb's law of electrostatic attraction. The force F with which any two quantities of electricity q_1 and q_2 attract one another, if they are at a distance r, apart is:

$$F = \frac{1}{C}\frac{q_1 q_2}{r^2}$$

in which C is the dielectric constant of the medium between the two charges.

The dielectric constant is then, for me, C, in Coulomb's equation. The same question arises here as in connection with the surface tension of liquids. Why should dielectric constants of liquids be discussed in these papers on the scientific and technical bearings of physical chemistry? Because it has been shown to be of great physical chemical importance.

It was first pointed out by J. J. Thomson, and a little later by W. Nernst, that there is a simple relation between the dielectric constants of media and their power to break molecules down into ions, and their dissociating power which is a fundamental physical chemical quantity.

Before going into this, a few words should be said in reference to a method of measuring the dielectric constants of media. A number of methods for this purpose have been proposed, but of these the simplest and probably the best is that devised by the German physicist Drude. It consists in passing long electrical waves—Hertz waves—down two parallel wires surrounded by the medium in question and measuring the lengths of the waves. The length of the waves is a simple function of the dielectric constant of the medium around the wires. The length of the electrical wave was shown by Drude to be inversely proportional to the square root of the dielectric constant of the medium in which the wires were immersed.

Dielectric Constants and Dissociation Power

The relation pointed out by Thomson between the dielectric constants of media and their dissociating power is this. The higher the dielectric constant of a liquid the greater its power to dissociate electrolytes dissolved in it. This conclusion is a consequence of the theory of electrolytic dissociation, and it was of interest and importance to see whether it held, and how closely and generally it was applicable to liquid solvents.

Of all the more common solvents water has the highest dielectric constant—about 78 at 18°—in terms of air as unity. Of all of the more common solvents water has the greatest dissociating power, as we shall see in a later chapter.

There are a few liquids with higher dielectric constants than water. Thus, liquid hydrocyanic acid has a dielectric constant of 95; formamide a dielectric constant of 84; sulphuric acid 84, while the dielectric constant of hydrogen dioxide is about 93.

All of these liquids have been shown to have greater dissociating power than water.

Of the more common solvents methyl alcohol has a dielectric constant of 33.7; ethyl alcohol of 25.9; liquid ammonia of, 22, chloroform of 5, ether of 44, carbon

[1]For a discussion of this application of surface tension, see "Elements of Physical Chemistry," H. C. Jones, 4th ed., pp. 145-150.

disulphide of 2.6 and benzene of 2.3; and these are just about their relative powers of breaking molecules down into ions—of disassociating electrolytes dissolved in them, as we shall see.

So confident have we now become of this relation between the dielectric constants of solvents and their dissociating power that the following incident occurred. When the power of solutions of electrolytes in liquid ammonia to conduct the current was first studied, it was concluded that it had greater dissociating power than water. This conclusion was based upon the fact that solutions in liquid ammonia conducted more than corresponding solutions in water. The dielectric constant of liquid ammonia was then determined and it was found to be somewhat less than one-third that of water.

The question of the large conductivity of solutions of electrolytes in liquid ammonia was then examined again, and this was found to be due not to the great dissociating power of this solvent, but to its small viscosity. There were not such a large number of ions present, but these mixed through the liquid ammonia so rapidly that they gave great conductivity. When this factor was taken into account, it was found that the dissociating power of liquid ammonia bore just about the same relation to the dissociating power of water, that the dielectric constants of the two media bore to one another.

While discussing the relation between the dissociating power of liquids and their physical and chemical properties, there is one other matter which must be mentioned. A relation, which holds approximately, has been worked out between the dissociating power of solvents and their own association. When surface tension was just being discussed, it was pointed out that a method, based upon the surface tension of pure liquids, had been worked out by Sir William Ramsay and Doctor Shields for determining the molecular weights of pure liquids, i.e., for determining the number of the simplest chemical molecules which were aggregated to form the so-called physical molecules. This method has been fairly extensively applied, so that we now know the approximate states of aggregation of most of the common solvents at ordinary temperatures. Of the more common solvents, water is the most associated. Then come methyl alcohol, ethyl alcohol, acetone, and finally those liquids which are only slightly associated, such as chloroform, carbon disulphide, the hydrocarbons, etc.

It will be seen that the solvents, with respect to their dielectric constants, stand in just about the same order as they do with respect to their own association. The more associated a solvent, in general, the higher its dielectric constant. Since dielectric constants and dissociating power are roughly proportional to one another, so also are the association of solvents and their dissociating power approximately proportional.

The discoverers of this relation were Dutoit, of the University of Lausanne and Miss Aston, working with him. Dutoit has clearly pointed out that this relation is only an approximation, and in some cases only a rough approximation. The relation, if only an approximation, is, however, interesting and important.

Iron Silver Mining Co.

The report of the Iron Silver Mining Co., operating at Leadville, Colo., shows for the year 1911 total shipments of 42,673 tons, of a net value of $10.04 per ton. Although the output is somewhat less than in preceding years, the gross return was greater, owing to a larger value per ton. The Leadville mill of the American Zinc Extraction Co., which formerly treated a large portion of the Iron Silver tonnage, closed early in 1911, but favorable contracts with other reduction works were made, which also cover 1912 shipments. The Moyer mine ores go to the Cañon City plant of the Empire Zinc Co., and the Tucson ores to the Western Chemical Manufacturing Co., of Denver. The American Smelting & Refining Co. takes the smelting ores.

Production and Treatment Charges

The production of the Moyer mine was: Zinc sulphide, 10,527 tons, gross value, $287,075; zinc-lead sulphide, 7962 tons, $359,660; lead sulphide, 1173 tons, $28,633; iron sulphide, 5325 tons, $62,175; lead carbonate, 22.7 tons, $162. The treatment charges against these classes of ore are as follows: Zinc sulphide, $21.65 per ton; zinc-lead sulphide, $36.58; lead sulphide, $5.04; iron sulphide, $8.13; lead carbonate, $4.27.

In the Tucson mine the tonnages and gross values of the various grades of ore were: Copper sulphide, 8199 tons, $260,461; zinc-lead sulphide, 6797, $254,359; zinc carbonate, 2006, $51,482; lead carbonate, 662 tons. The treatment costs on these classes were respectively $8.62; $30.95; $19.73; and $2.47 per ton.

Total productions were: 1752 oz. gold; 571,736 oz. silver; 4,398,318 lb. lead; 13,025,891 lb. zinc; 4,125,661 lb. iron; and 350,487 lb. copper. There was also a production of 4143 tons of ore by lessees, which paid $3697 in royalties.

Results of Exploration

Development consisted of 9451 ft., the largest amount of work done on the property in any year: 7553 ft. of drifts; 1861 of raises, and 37 of winzes. The results obtained in this development were in the main satisfactory, and the present year opened with good ore reserves.

While the Moyer mine, as in previous years, contributed the bulk of the output, the remaining ore in the South Moyer is being rapidly exhausted, and the old ground can only be expected to yield a small future production. The workings from the South shaft were carried forward an additional 517 ft. into the lower horizons of Rock Hill, but the results obtained were not encouraging. The pay ore in the North Moyer has been completely mined, and vigorous prospecting has failed to find any new orebodies, and active mining operations were suspended there late in the year.

However, prospecting in the hitherto unexplored territory adjacent to the South Moyer, south of the Moyer fault, disclosed an orebody parallel to the main shoot of an average width of 25 ft., and of undetermined length, consisting of galena, blende and pyrite, with about 8 oz. silver to the ton. The ore already blocked out will keep up the contracted production for several months to come.

The upper levels of the Tucson mine were explored for oxidized zinc ores, but no appreciable amounts were disclosed of marketable ores, although a large body of 24% zinc ore was discovered on the first level. Some marketable oxidized lead ores were discovered in the search for zinc ores on the second level. Zinc-lead ore was discovered on the fifth level. The copper output for the year came from the levels below the fifth, but extensive prospecting showed that these deposits were limited and a maintenance of the copper-ore production cannot be expected during the coming year.

The Stevens mine, closed in 1902, on the exhaustion of oxidized lead ores, was reopened and zinc ore prospected for. However, the veins found on the first level were too small to be payable, but prospecting from a station 98 ft. below this level, and 12 ft. above standing water level is now being done.

An excess of income over expenditures of $187,640 was received, from which dividends of 1% or $100,000 were paid, the year closing with a surplus of $355,291, of which $355,272 was in cash.

Nisi Prius

The known orebodies on the property of the Nisi Prius Mining Co., controlled by the Iron Silver interests, have been practically exhausted, and the attraction to lessees has become very slight. However during 1911 there was a desire to explore the old workings for zinc, and a revival of mining was experienced. The Reindeer mine was worked throughout the year without developing anything of importance. In the Crown Point mine small deposits of zinc carbonate were found, but they were not payable. On the Estey lease a new shaft was sunk to 275 ft., and drifts are now being run to explore the ore-bearing contact.

Caving System at Ohio Copper Mine

By Clarence G. Bamberger*

Mining by the caving system as used by the Ohio Copper Co., in Bingham Canyon, Utah, compares favorably in regard to cost with steam-shovel mining. Upon driving a network of raises and sublevels the ore breaks and is drawn through chutes to the Mascotte haulage tunnel; the capping comes down upon the surface of the broken ore.

*Salt Lake City, Utah.

There are in general but two methods of mining deposits of this type in use; the stripping of the overburden and the mining of the ore by steam shovels, when the deposit lies near the surface; and some form of caving-system when the deposit is deeper.

In certain places, especially Butte, the square-set method of stoping has been in successful operation on comparatively large low-grade copper deposits, but owing to the excessive cost, this method, has narrow limitations. The system employed in most of the low-grade copper deposits, popularly called "the porphyries," is the first, or steam-shovel method, or a combination of the two.

On deposits where the average overburden is but a little over 100 ft., and where about three tons of ore are uncovered per ton of stripping, the steam-shovel method has been successful both as to large output and low cost. A notable example is the operation of the Utah Copper property. Quoting the annual report of this company for the year 1910: "Of the total ore mined 82% was mined by steam shovels and 18% by underground methods. The average cost of mining was 40.97c. per ton, of which 13.3c. was charged to development and stripping expense, leaving 27.67c. as the actual cost of shoveling the ore. The total cost of producing 20% of the underground ore was approximately the same as that of producing the other 80% by steam-shovel method."

Thus it appears that the actual cost of mining ore by the steam-shovel method was 17.25c. per ton against 69c. by underground mining, the relative cost of production per unit by the latter method being approximately four times that by the steam-shovel method.

Conditions Favorable for a Caving System

The purpose of this article is to describe a system of underground mining wherein the costs per unit are made to approach more nearly those obtained by the steam-shovel method. It, however, in no way advocates such a method as being preferable to steam-shovel methods in all cases as undoubtedly each system has its particular adaptation due to existing conditions.

A striking example of low cost for underground mining is found in some data of operations at the Ohio Copper property in Bingham Cañon, Utah. The following description of existing conditions will enable a better understanding of the methods practiced there.

The country rock is in general quartzite. Merging into this formation is a large laccolithic mass of monzonite. Both the quartzite and the monzonite are mineralized, the latter usually containing more copper than the former. Two well defined parallel fissures about 450 ft. apart, with an easterly strike, dip into the mountain at an angle of 45°. The filling of these fissures forms what will be considered here as the vein. It will be assumed that these fissures are at the hanging- and foot-wall contacts of the vein and that they inclose a body of mineralized quartzite and monzonite about 400 ft. in width. This body of quartzite is much broken and shattered. Disseminated throughout this mass, with a certain concentration along cleavage planes, copper ore exists in the form of chalcopyrite, bornite and in places chalcocite. The entire mass is of about the same average copper tenor, however, where a secondary enrichment has taken place, chalcocite and native copper are found, and in the neighborhood of porphyry intrusions an enrichment has taken place. It will be assumed in this discussion that the copper tenor of the entire mass is approximately uniform.

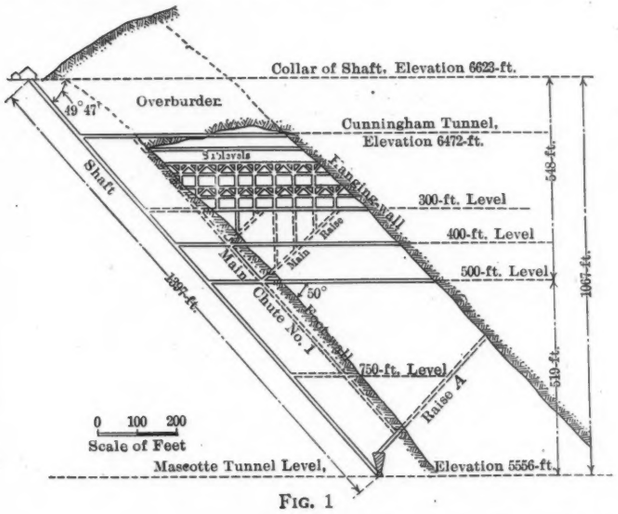


FIG. 1

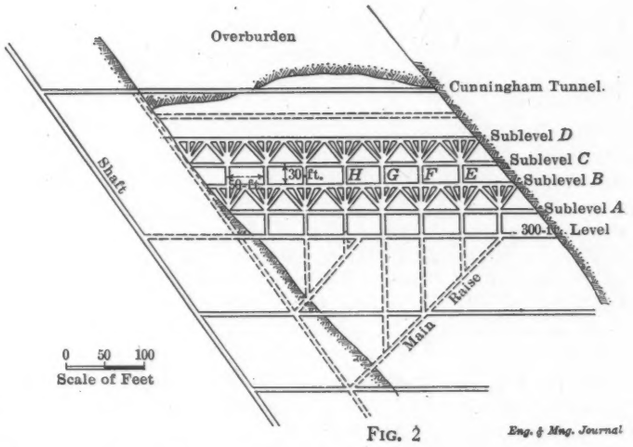


FIG. 2

Eng. & Mng. Journal

CROSS-SECTIONS, OHIO COPPER MINE, SHOWING PREPARATION FOR CAVING

In order to meet such conditions a system of underground mining was devised to handle a large tonnage at a minimum unit cost. By closely following the description of the methods employed as herein stated and the accompanying cost data, the work being accomplished at this property will be more fully appreciated.

In résumé the conditions are: An orebody opened 400 ft. in width, 450 ft. in length, 1300 ft. in depth, dipping from the horizontal at an angle of 50°. The entire mass being a broken shattered quartzite containing copper, chiefly in the form of chalcopyrite disseminated throughout, inclosed by foot and hanging wall of the same formation with boundaries not clearly defined.

Many Sublevels and Raises Necessary

The preparation of this ground for a caving system of mining has been carried out as shown in Fig. 1. An incline shaft was sunk in the foot wall on the dip of the vein connecting with the different levels for the transportation of men and supplies. Two main ore chutes No. 1 and No. 2 were driven in the foot wall on an angle slightly greater than the dip of the vein. These chutes were driven in the foot wall because the ground stands better than in the orebody itself. Driving the chutes in the orebody is the ideal method as in their preparation no dead work is required. These chutes connect by diagonal raises through the foot wall, with the different levels where extraction is taking place and deliver into bins of large capacity at the Mascotte tunnel or main haulage adit which in turn leads to the concentrator situated at the portal about three miles distant.

Lateral main levels were driven across the orebody at the 100-, 300-, 400-, 500-, 750- and 1000-ft. or haulage level. By a network of crosscuts and drifts these different levels have been cut up into blocks 200 ft. square which in mining will again be subdivided. Between the several levels the ground has been blocked out into sublevels 30 ft. apart and again subdivided by crosscuts, drifts and raises into blocks approximately 30x50x25 feet.

The actual procedure of extraction can be clearly understood by reference to Fig. 2 which shows in detail the sublevels above mentioned. Thus we have for example the four sublevels, *A*, *B*, *C* and *D*. Raises are driven from the crosscuts and drifts on the 300-ft. level through sublevels *A* and *B*. From these vertical raises at the various points *E*, *F*, *G* and *H* raises are run into sublevel *C*, radiating like fingers from the palm of the outstretched hand. At the breast of these several raises sublevel *D* is blasted down, the ore falling by these leads into the cross inclined chutes connecting with the main ore chute which delivers into bins at the loading-station on the haulage-tunnel level.

The same procedure is carried out on sublevel *B* which in turn is blasted down; at the same time sublevel *C*, which has already been cut up by this finger-like network of raises, comes with it as the solid ground below is blasted down. Thus each alternate sublevel is cut up by the numerous raises and the corresponding sublevel above and below is blasted down.

Ore Run to Haulage Level without Handling

The capping can either be previously removed by steam shovel or, as is the more general practice, allowed to come down with the ore, care being taken that it always rests on the top portion of the ore as it is broken down and that the drawing of the ore is stopped when the capping appears. As a result there is continually being broken down and drawn a mass of ore with the capping resting on it, the surface contour changing and an immense depression not unlike a glory hole being formed.

In the actual operation of mining the ore is never handled, falling along inclined planes by gravity and delivering into cars at the haulage-tunnel level.

TYPICAL DAILY LABOR REPORT. OHIO COPPER CO.

Description of Labor	Number	Rate	Amount
Superintendent	1	11.66	11.66
Foremen	2	5.33	10.66
Shift bosses	3	4.00	12.00
Timekeeper	1	3.00	3.00
Sampler	1	3.00	3.00
Mine engineer	1	5.00	5.00
Hoist engineer	2	3.25	6.50
Stationary engineer	2	3.50	7.00
Chainman	1	3.50	3.50
Tool sharpener	2	3.50	7.00
Machine men	21	3.25	68.25
Machine men	8	3.00	24.00
Muckers	23	2.50	57.50
Muckers	10	2.75	27.50
Loaders	2	3.25	6.50
Loaders	3	3.00	9.00
Chute tappers	3	3.00	9.00
Nippers	2	2.50	5.00
Blacksmith	1	4.25	4.25
Blacksmith's helper	1	3.25	3.25
Carpenter	1	4.00	4.00
Carpenter's helper	1	3.25	3.25
Trackman	1	3.00	3.00
Trackman's helper	1	2.50	2.50
Pipeman	1	3.25	3.25
Pipeman's helper	1	2.75	2.75
Timbermen	7	3.25	22.75
Timbermen's helpers	7	2.75	19.25
Total	110	.....	$344.32

Total labor charge for Oct., 1911		$11,582.78
Total stores consumed for period		3,743.82
Total power consumed for period		476.00
Total operating expense for period		$15,802.60
Total development and equipment for period		3,429.00
Total actual operating expense for period		$12,373.60
Average number of feet driven per day		31
Average number of feet raised per day		42
Average tons mined per day	1,817	
Total number of feet driven for period	.....	961
Total number of feet raised for period		1302
Total tonnage mined for period	56,311	

All calculations based on wet weight.

There trains are made up and trammed by electric locomotive to the concentrator at the tunnel mouth.

The actual cost per ton for the different phases of the operation is shown in the accompanying table which is an average covering a period of 31 days in October, 1911, during which period 56,311 tons were mined.

From the above data several interesting conclusions can be drawn. Considering the whole working force of 110 men as producing the ore, approximately 17 tons of ore are delivered to bins per day per man. Considering, however, only the men who are actually breaking the ore, approximately 63 tons of ore are delivered to bins per day per man. From the "total operating expense for period" and "total tonnage mined for period," the cost per ton delivered to bins is shown to be 28.06c. which figure includes development and equipment charges. From "total actual operating expense" and "total tonnage mined for period," the actual cost per ton for mining delivered to bins is shown to be 21.97 cents.

This cost per unit is at the present time the minimum cost for operating underground under like conditions. The application of this system of mining has permitted and will permit of the development and operation of copper deposits, which until recent times have been considered of no commercial value. In conclusion, I wish to thank Alfred Frank, the general manager, under whose personal direction this work is being carried out, for his kindness and the information given me for use in this article.

Electrolytic Detinning

The original electrolytic method of detinning was worked out by Hette in 1876, says *Bull. Technologique de Agriculture et Mines,* Nov., 1911, and consisted in electrolyzing the tin scrap in a 10 to 12% sodium-hydrate solution, heated to 60 to 70° C. The current density was 100 amp. per sq.m., and the resistance 1.5 to 2 volts. The scrap was placed in iron baskets, and served as anodes.

With 50 tanks three meters cube, and three baskets per tank, each basket held about 60 kg. of clippings, the electrolysis lasted five to seven hours and the original works treated about 9000 tons of clippings per year.

A more recent process, that of Meunicke and Steiner, uses a solution of sodium sulphide heated to 90° C. The current density is 50 amp. per sq.m., and the resistance under 0.2 volts. Tin is deposited on the cathode, and other metals are precipitated as sulphides. The following reactions take place:

$$2\ Na_2S + Sn = SnS_2 + 4\ Na$$
$$4\ Na + SnS_2 = 2\ Na_2S + Sn$$

If the resistance per cell exceeds 0.2 volts the sodium sulphide is not regenerated, because of:

$$Na_2 + 2\ H_2O = 2\ NaOH + H_2$$

The cathodes are pure tin, and the electrolyte ought not to contain iron, copper, or antimony. Each time the anodes are changed, 1% of sulphur ought to be dissolved in the bath.

Over a million and a half acres of public land now stand withdrawn by the Government as being valuable for the possible development of water power.

The Mathematics of Copper Sampling

By Edward Keller*

A discussion of the interior structure of copper bars, and a demonstration of a method of sampling by which each separate hole can be made to represent the average of the bar in which it is placed. The commercial method merely attempts to make the average of all the holes represent the average of all the bars.

*Perth Amboy, N. J.

In the issue of the JOURNAL for Dec. 16, 1911, Donald M. Liddell calls attention to possible errors in sampling argentiferous-auriferous copper bars by drilling, due to their shape and consequent incorrect size-weight ratio of the drillings, or of the drill-hole cylinder in relation to those stereometric units of the bars whose cross-sectional area is laid out on the surface by the template. As a remedy, Mr. Liddell advises thin slabs with little bevel. Since Mr. Liddell proceeds in his argument from an entirely mathematical, or theoretical viewpoint, let us follow on the same lines to their ultimate consequences. Although I do not pretend to be a mathematic critic, yet it would seem to me that in this case Mr. Liddell has fallen short of drawing the full logical conclusions in his argument. We shall presently see that the suggested remedy, as far as it concerns the bevel of a bar or slab, is not theoretically a remedy.

ELIMINATION OF BEVEL DOES NOT ELIMINATE ERROR

Taking the thin slab[1] for our analysis, we would say: If a reduced bevel reduces the error, an eliminated bevel will eliminate the error of sampling. This conclusion would be true if the geometrical form of the slab were the sole factor in making up a correct sample, for as will readily be seen from Fig. 1, a vertical section through an ideal copper slab, where drillhole D_1 through parallelepiped P_1, of which $A\ B\ A'\ B'$ is the vertical section, has the correct size-weight ratio. However, apart from the external geometrical form there exists an internal structure quite dissimilar to the former and composed by numerous invisible geometrical units which, in a theoretically correct sample, should each be represented by its proper size-weight ratio. This internal structure is caused by the rearrangement of the silver and gold contents in the copper when the latter passes from the molten to the solid state.

We may assume the molten metal (alloy, bullion) to be homogeneous, but as soon as solidification begins there takes place a differentiation of the contents in silver and gold, due to changes in osmotic pressure and consequent diffusion.

We may now assume that the solidification proceeds so as to form even layers from all the surface planes of the slab (in reality there is, of course, irregularity) and that each successive layer differs in composition from its predecessor, the silver and gold tenor increasing from the surface to the center. (In certain cases the reverse takes place.) These imaginary layers are shown in the figure as ⅛ in. thick, by continuous lines and as meeting at right angles (in the actual freezing of the copper the corners are rounded). We now have in the slab two sets of horizontal layers; one set formed from the top, the other from the bottom and meeting along the line *XY*. Then we have vertical layers around the four sides; a section of one being shown in Fig. 1. The zone of vertical layers will herein be called the edge zone, as we have no bevel.

SIZE-WEIGHT RATIO FOR SEGREGATION LAYERS INCORRECT

If we now examine drill-hole cylinder D_1, we note that is passes a part of the horizontal layers and then includes four vertical layers in their full length; all of them, however, being of different composition. In the parallelepiped P_1, these layers are represented by rectangular prisms of equal cross section, but of unequal altitude; their size-weight, therefore, being proportional to their altitude. It follows, that to obtain their proper ratio in the sample, we must cut them in their full cross section, which could be accomplished with a square or rectangular hole, as shown in horizontal section *S*. The round drill-hole through the vertical layers can never give a theoretically correct sample; the ratio of the layers being as incorrect as the segments 3′, 4′, 5′ and 6′ in horizontal section *D* differ from each other in area. But, in the edge zone the round drillhole does not even properly sample the horizontal layers; in parallelepiped P_1, layer 1 covers its full horizontal cross section; all the others but decreasing portions of it. Layers 1, 2 and 3 receive the full cross section of the drillhole, therefore, 2 and 3 more than their proper ratio. Quite similar are the errors in P_2.

It must, from the foregoing, appear clear that D_1 and D_2 do not properly sample the edge zone and that to obtain the theoretically correct ratios of all the internal geometrical elements of this zone

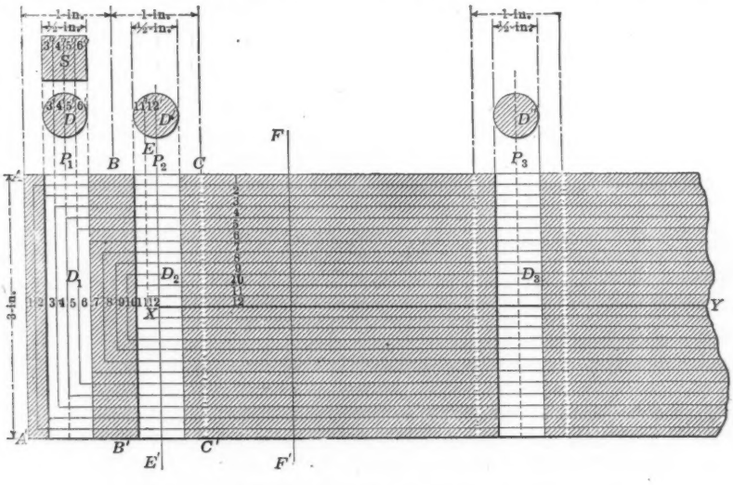


FIG. 1. VERTICAL SECTION OF IDEAL COPPER BAR

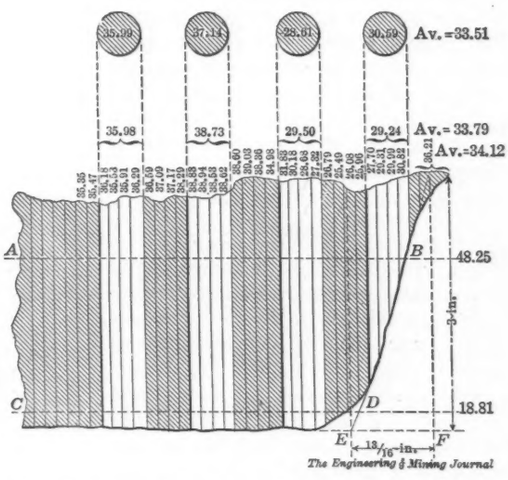


FIG. 2. SILVER ASSAYS OF COMMERCIAL BULLION

[1]The thin slabs of practical metallurgy are of 2 or 3 in. thickness and from 15 to 20 by 24 to 30 in. horizontal dimensions.

nothing but a continuous section will answer; we must take a sample with saw or planer. The theoretical definition of this edge zone is given in Fig. 1, comprising the area from the edge *A A'*, to the line *EE'*, which passes through the point *X*, at which diffusion in the horizontal direction theoretically stops.

By the continuous section through the edge zone we not only obtain a correct sample of it but, as the zone contains all the elements of diffusion derived from the original, homogeneous, molten metal, it is also a correct sample of the whole slab. Naturally, therefore, that remaining portion of the slab within the edge zone, beyond the line *EE'*, will also contain the average contents of the whole slab and, as this portion is composed entirely of horizontal layers, each of uniform thickness and extent, it is but necessary to drill a single hole at any one point (D_s) to obtain the theoretically correct size-weight ratios of all the layers and a correct sample of the whole slab. This appears as the simplest mathematical solution of theoretically correct sampling of metallic slabs; it eliminates the complicated edge zone, or bevel, from consideration and makes the inconvenient and expensive procedure of sawing, or planing, unnecessary.

Practice Proves One-Hole Sampling Correct

A correct theory will, indubitably, give correct practical results. I have repeatedly demonstrated that the one-hole scheme and the full-template scheme yield results well within the usually accepted commercial limits, an example of which has but recently been published.[2] As a modification of the one-hole scheme, a template with a much restricted number of holes might be laid out for the inner field of the slab.

In making suggestions on the foregoing lines to a colleague, he said: But, suppose you were dealing with a concern which would place iron bars around the edge of the slab? Such ethics would be unfortunate, yet some of us are still professionally somewhat unsophisticated, for the reason that no other demands, from responsible side, have been made, than the delivery of anything but bare facts, or the demonstration of anything than the naked truth.

A discussion of this kind without due consideration of the practical side of the subject in a journal devoted to practical work would be useless. To reassure those interested in these problems, in a practical and financial way and who may be afraid of iron bars, or who think, for other reasons of their own, that the whole slab should be sampled, it must be acknowledged that the magnitudes in contention between Mr. Liddell and me are of a small order and that they seem to become totally lost in the much larger ones of the irregularities which make up the composition of the actual slab.

[2]E. Keller, Bull. A. I. M. E., June, 1911.

Quarter Section Templates Preferable

Besides, the templates for the drillholes are generally laid out in approximate inch squares, insuring the drilling of many holes, and the law of averages plays an important rôle. It is, without doubt, preferable to cover only one-half or one-fourth of a slab with a template of small squares than the whole slab with a template of larger squares. This statement will be substantiated in the concrete figures that will follow.

It is not the object here to produce many figures, but one extreme example may serve a useful purpose: If it can be demonstrated that fairly uniform results are produced by various modes of sampling a highly heterogeneous copper slab, we are then justified in the conclusion, that a sample from a hundred, or several hundred, slabs of similar composition will be still more reliable. Such a slab was sampled in eight lateral zones: (1) a cut ½in. wide by planer, near the center line, horizontally through the whole width of the slab; (2) adjoining the first, a cut 3 in. wide through one-half the width of slab; (3) and (4), to either side of (1) and (2), drilling three holes, in line, in center of every inch of the width of slab, the latter top surface up; (5) and (6), adjoining (3) and (4), in the same manner as these, but bottom surface of slab up; (7), *X* end of slab, bottom up, drilling by regular,1-in. template, 72 holes; (8), *Y* end of slab, top up, in the same manner as (7), 91 holes. In each of the last two zones the drillings from all the holes were united. With the other zones, the drillings from each template section, 1 in. square, were weighed and assayed separately. Cut (1) was taken in ⅛-in. layers, horizontally, each weighed and assayed separately, thus giving the distribution of the metals in the vertical direction. Cut (2) was taken in layers as the former, but vertically, thus showing the distribution of the metals in the horizontal direction. All samples were used up, except the last fractional assay ton, in assaying. All average assays are figured according to weights of individual samples. The results are incorporated in the table.

SILVER CONTENTS OF ZONES OF SLAB

Sample	Oz. per Ton
Horizontal cut	34.23
Vertical cut	34.53
Drillings, top, *X*	34.22
Drillings, bottom, *X*	34.32
Drillings, top, *Y*	33.28
Drillings, bottom, *Y*	33.67
Drillings, end, bottom, *X*	34.65
Drillings, end, top, *Y*	34.06

Fig. 2, a vertical section of a portion of the slab under examination illustrates the great heterogeneity of the material. The extremes in silver tenor in the vertical direction are given as along the lines *AB*, 48.25 oz., and *CD*, 18.81 oz. This figure, however, is chiefly designed to show the constitution of the edge zone, the correct ascertainment of its composition by a continuous cut, the composition of the drill-hole cylinders and the composition of the corresponding sections of the vertical cut in an adjoining zone.

Gold is Correct When Silver Is

It is not probable that anyone will dispute the close concordance of all the foregoing comparative results and averages of the silver contents in this slab; they were a surprise to me in view of the much reputed heterogeneity of the material. The gold has not been given consideration here, because in my experience there is no case in which the heterogeneity of the gold approaches in degree that of the silver; therefore, whenever the correct silver tenor is ascertained that of the gold is assured with it. Generalizing on practical sampling on a large scale, it may be stated, that the results at two different copper works now not only agree within 1 oz., but generally within 0.5 oz. or 0.25 oz., and not infrequently within 0.1 oz. of silver; one of the methods of sampling being by shotting the homogeneous furnace charge, the other by drilling the slabs, bevel or no bevel and crude or refined, according to such templates as have already been mentioned. Recent observations have brought me to the conclusion, that it is not yet self evident to everyone connected with this practice, that drill-holes must extend through the entire thickness of a slab or bar.

Having described, somewhat, theory and practice, each by a figure, the question, "what is the difference between the two?" naturally suggests itself. The only modification to be introduced into Fig. 1 to make it the section of a reality, would be to move the point *X* considerably inward, about to the line *FF'*. In ordinary converter copper the diffusion towards *X* causes a depression of the freezing point of the copper and a consequent retardation of solidification, as also a horizontal extension of the diffusion zone. The line *XY* in reality is much removed towards the upper surface, because the mold at the bottom absorbs more heat than does the air on top, therefore a much more rapid freezing from the bottom. The indicated (imaginary) layers below the line *XY* would as a consequence be thicker than those above that line.

In Fig. 1 we may see that a copper bar with a square cross section, or one approaching it, is composed of two edge zones of a slab, symmetrically joined together; the most irrational form for the purpose of sampling by drilling.

Concrete figures may here be given: The point X is now in the center of the bar; each layer extends around the four sides; the drill-hole D_2 passes vertically through point X, including in its section the entirety of layers 11 and 12, in an argentiferous bar the richest (or poorest) in silver, while layers 10 to 1 are represented in the same section in decreasing ratios. Ignoring the overlappings of the layers at the corners, an error which but reduces the evident impropriety of the drill-hole sample at this point, we have the simple relations as expressed in the following table, which apply to the edge zone as well:

INCORRECT RATIOS OF DRILLHOLE IN SQUARE BAR OR EDGE ZONE

Layer No....	1	2	3	4	5	6	7	8	9	10	11	12
Ratio in D_2..	$\frac{1}{12}$	$\frac{1}{11}$	$\frac{1}{10}$	$\frac{1}{9}$	$\frac{1}{8}$	$\frac{1}{7}$	$\frac{1}{6}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	1	1

Proper Wire Bar Sampling

For argentiferous copper, the thin slab has been advocated and largely adopted for at least 15 years; for such copper the thick bar should be discontinued entirely. However, there are other copper castings which, with their approximately square cross sections, will remain. These are the marketable forms of refined copper, such as wire-bars, etc. Of these the exact copper contents are frequently required. This copper contains approximately 0.1% of oxygen, or 0.9% of cuprous oxide. From E. Heyn[3] we have learned that the copper-cuprous-oxide eutectic contains about 3.5% of the oxide. The wire bar is, therefore, a subsaturated solution of the oxide in copper and for that reason, the former probably concentrates strongly towards the freezing center of the bar. A sample drilled through the center of the bar would yield low results; one from the cleaned surface high ones. The latter, however, would approximate the true content more closely than the former, because along the contact with the mold the freezing is so rapid that there is little time for diffusion. Only a full cross-section of such material would yield a correct sample.

Whatever has here been demonstrated, theoretically or practically in relation to argentiferous copper, would equally well apply to any other bullion or alloy.

The following minerals are given by the U. S. Geological Survey as the American minerals used in the paint trade without change in their chemical composition: Asbestos, asphalt, barytes, brown slate and shale, clay, graphite, gypsum, hematite, limonite, magnesite, ocher, pyrite, shells, siderite, silica, sienna, talc, umber and whiting.

[3]Mitth. Kgl. Tech. Versuchsanstalten, Jahrg. 18, 315, 1900.

The Dwight-Lloyd Process in Iron Metallurgy

The general description of the Dwight-Lloyd straight-line sintering machine is well known to the JOURNAL readers[1] as is also the fact that it has been used in sintering iron-blast-furnace flue dust[2]. Further details of this operation were presented by J. G. Klugh at the February meeting of the Institute of Mining Engineers. Since Oct. 1, 1911, the process has been used at Birdsboro, Penn., at the blast furnace of the E. & G. Brooke Iron Co. The material treated was the current flue dust and material from an accumulated stock pile which was high, but not uniform, in carbon, so that desirable control or regularity of the amount of fuel in the mixture treated could not be maintained.

Nevertheless, the sinter produced was in all cases of excellent quality. It has been found that an amount of carbon equivalent to 8% of the weight of the ore to be sintered furnishes ample heat for the production of the sinter. Carbon in excess of 8% consumes too long for its combustion, raises the temperature of the sinter to its fusing point thus enveloping unconsumed carbon and raises the temperature of the grate bars and other parts of the machine. For economic reasons, too, it is desirable to have a minimum consumption of carbon and a maximum production with the most desirable quality of product. From a given material with the correct percentage of fuel, the character of the sinter depends wholly upon the material itself, being unaffected by the speed of sintering or the velocity of air supply. Consequently, the rate at which the machine can be run depends upon the permeability of the bed of material and the pressure drop between the atmosphere outside and that in the wind box.

Water Added Before Sintering

Water is always added to these flue dusts before sintering, which largely influences the permeability, although the complete function of the water is not understood. Primarily, it causes a temporary agglomeration of the particles of the material, thus preventing them from passing through the grate. The interstices in the bed are then larger, offering less resistance to the gas current. The percentage of moisture added is not a given percentage by weight, but the quantity required to produce a certain degree of plasticity. For instance, to a fine hematite ore there should be added 15% by weight of water, but with magnetite 4% would produce the same result. The regulation of this phase of the process is very important, but has as yet been done by rule of thumb only.

When high-carbon material follows low-carbon material, the only adjustment necessary for the machine is to slow down the speed of the pallets, allowing greater time for burning out the excess of carbon. Residual carbon is only left in the sinter when the temperature in the upper part of the bed is raised so as to render it incipiently fluid and permit it to envelope small amounts of carbon. This will only occur when the carbon is high, say above 20%. Desulphurization is usually good, but seems independent of form or quality of the ore. Pyrite cinder was brought down from 4.41 to 0.07%, while magnetite was lowered in sulphur from 3.50 to 0.15 per cent.

There is no analogy in the working of this Dwight-Lloyd sinter and mill cinder. One is a mere agglomeration of highly porous material, the other is a completely fused glass, that is, a satisfied chemical compound giving up its oxygen only at high temperature and affording a minimum area of contact for reducing gases.

Several times, as much as 10% of easily reducible Lake ores have been replaced by sinter. The management of the Birdsboro furnaces believes that taking off the ore and putting on the sinter has the same influence on the fuel consumption as would result from taking off entirely the given amount of ore burden. When mill cinder is used with a burden of a high percentage of magnetic ores, a scouring action is often noticed, especially when the mill cinder is used to the amount of 12 per cent., no such action being observable with Dwight-Lloyd sinter. The wider use of the Dwight-Lloyd process for the preparation of the blast-furnace charge is strongly recommended by the author.

[1]Eng. and Min. Journ., Aug. 13, 1910.
[2]Eng. and Min. Journ., July 15, 1911.

Age Distribution of North German Miners

In view of the agitation for workmen's compensation laws and pension systems, the accompanying table which has been sent us by Frederick L. Hoffman, statistician of the Prudential Insurance Co. of America, will be of interest. This table is taken from the German Occupation Census for 1907, and shows the age distribution of miners in the North German Miners' Pension Fund.

AGE DISTRIBUTION OF MINERS

Age attained	Males	%	Females	%
16-18	6,182	5.3	150	9.5
18-20	7,547	6.5	219	13.9
20-25	16,309	14.1	281	17.8
25-30	18,570	16.1	316	20.1
30-40	31,489	27.3	298	18.9
40-50	22,083	19.1	200	12.7
50-60	11,023	9.5	87	5.5
60-70	2,226	1.9	21	1.3
70 and over..	132	0.1	4	0.3
Total	115,561	100.0	1,576	100.0

The Mining Index

A Classified Bibliography of the Current Literature of Mining and Metallurgy

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NONMETALLIC MINERALS

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18,444—OIL WELL—Some Mechanical Features of an Oil Well. Dorsey Hager. (Min. and Eng. Wld., Mar. 23, 1912; 1 p., illus.) 20c.

18,445—ORIGIN—Fallacies in the Theory of the Organic Origin of Petroleums. Eugene Coste. (I. M. M.; Bull. 89, 1912; 4 pp.) Contributed remarks on paper previously indexed.

18,446—PENNSYLVANIA—Geologic Atlas of the United States, Claysville Folio, Penn. M. J. Munn. (U. S. Geol. Surv., 1912; 19 pp.)

18,447 — SOUTHERN STATES — Vast Storehouse of Fuel in Southern Petroleum and Natural Gas. David T. Day. (Mfrs. Rec., Feb. 22, 1912; 1½ pp.) 60c.

18,448—UTAH—Geology of the San Juan Oil Field, Utah. E. G. Woodruff. (U. S. Geol. Surv., Bull. 471-A, 1912; 35 pp., illus.)

18,449—WYOMING—The Powder River Oil Field, Wyoming. Carroll H. Wegemann. (U. S. Geol. Surv., Bull. 471-A, 1912; 22 pp., illus.)

ECONOMIC GEOLOGY—GENERAL

18,450—DURANGO—Estudio Geologico y Minero de la Sierra de el Oro, Durango. Villar Roldan. (Bol. Sociedad Geologica Mexicana, 1911; 20 pp., illus.)

18,451—ORE DEPOSITS—The Superficial Appearance and Alteration of Ore Deposits. George J. Bancroft. (Proc. Colo. Sci. Soc., June, 1911; 54 pp.)

18,452—OXIDATION OF SULPHIDES. Second Paper. V. H. Gottschalk and H. A. Buehler. (Econ. Geol., Jan., 1912; 20 pp.) 60c.

18,453—QUEBEC—Géologie du Canton de Fabre, Comté de Pontiac. Robert Harvie. (Ministère de la Colonisation des Mines et des Pecheries, Bureau des Mines, Quebec, 1911; 36 pp., illus.)

18,454—VOLCANISM—Brun's New Data on Volcanism. A. N. Winchell. (Econ. Geol., Jan., 1912; 14 pp.) 60c.

MINING—GENERAL

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18,457—BLASTING—Investigations of Fuse and Miners' Squibs. Clarence Hall and Spencer P. Howell. (U. S. Bureau of Mines, Tech. Paper No. 7, 1912; 19 pp.)

18,458—BOLIVIA—Mineral Resources of Bolivia. Carlos Sanjines. (Min. and Sci. Press, Mar. 9, 1912; 2¼ pp., illus.) 20c.

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18,491—CONCENTRATING SANDS AND SLIMES—Das Filter bei der Aufbereitung feiner sulphidischer Sande und Schlämme. M. Moldenhauer. (Metallurgie, Feb. 8, 1912; 3½ pp., illus.) The filter in concentrating fine sulphide sands and slimes. 40c.

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18,504—ASSAYS — Quick Combination Methods in Smelter Assays. A. T. French. (I. M. M. Bull. 89, 1912; 18 pp.)

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18,507 — COPPER-ZINC ALLOYS — Further Experiments on the Critical Point at 470 Deg. Cent. in Copper-Zinc Alloys. H. C. H. Carpenter. (Engineering, Feb. 23, 1912; 3½ pp., illus.) Paper before Institute of Metals, Jan. 17, 1912.

18,508 — EXTRACTION TESTS — A Graphic Method of Illustrating the Results of Extraction Tests. H. K. Picard. (I. M. M., Bull. 89, 1912; 3 pp.)

18,509—FURNACE CHARGES—Calculation of Furnace Charges—III. Regis Chauvenet. (Met. and Chem. Eng., Mar., 1912; 4 pp.) 40c.

18,510—FURNACE WALLS—The Flare of Furnace Walls. Carl Hering. (Met. and Chem. Eng., Mar., 1912; 1 p.) 40c.

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18,512—LABORATORY — Das Metallhüttenmännische Institut der Königlichen Technischen Hochschule zu Breslau. K. Friedrich. (Metallurgie, Jan. 22 and Feb. 8, 1912; 18 pp., illus.) 60c.

18,513—METALLOGRAPHY—Ueber die Darstellung Umwandlung von Atom-bzw. Molekularprozenten und Gewichtsprozenten in multiplen Systemen. F. Hoffmann. (Metallurgie, Feb. 22, 1912; 9 pp., illus.) 40c.

18,514—ORE DRYING—Abrasion and Dust Losses in Ore Drying. Carl F. Dietz and Dyke V. Keedy. (Advance proof, A. I. M. E., Feb., 1912; 22 pp., illus.)

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18,526—CONVEYORS—A Study of Mechanical Conveyors — I. Lincoln D. Moss. (School of Mines Quart., Jan., 1912; 19 pp., illus.) Extracts from lectures before the Dept. of Mech. Engineering, Columbia University. 60c.

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18,531—GAS PRODUCERS—Die Gewinnung der Nebenerzeugnisse beim Gaserzeugerbetrieb. Anton Gwiggner. (Stahl u. Eisen, Dec. 21, 1911, and Feb. 1, 1912; 1 p.) The saving of byproducts in operating gas producers. 60c.

18,532—GAS PRODUCERS—The Gasification of Fuel—II and III. Typical Forms of Producer Construction. Charles E. Lucke. (Eng. Mag., Feb. and Mar., 1912; 13 pp., illus.) 80c.

18,533—HOIST—Electric Hoist at Negaunee Mine. P. B. McDonald. (Eng. and Min. Journ., Feb. 24, 1912; ½ p., illus.) 20c.

18,534—HOIST—Electrical Control of a Large Hoist. H. W. Cheney. (Proc. A. I. E. E., Mar., 1912; 16 pp., illus.)

18,535—HOISTING—Electric Winding on the Rand. (Elec. Rev., London, Mar. 8, 1912; 2 pp., illus.) 40c.

18,536—HOISTING—Safety Devices for Hoisting through Inclines. L. E. Ives. (Eng. and Min. Journ., Mar. 9, 1912; 1 p.) 20c.

18,537—HOISTING ENGINE—Abnahmerversuch an einer Dampffördermaschine. (Glückauf, Feb. 17, 1912; 2 pp., illus.) Communicated by the boiler inspectors of Dortmund district. 40c.

18,538—HOISTING ENGINES—Selbsttütige Geschwindigkeitsregelung an Dampffördermaschinen. Schönfeld. (Glückauf, Feb. 24, 1912; 3½ pp., illus.) Automatic speed regulation at steam hoisting engines. 40c.

18,539—HYDRO-ELECTRIC PLANT—New Hydro-electric Plant of Northern California Power Co. Rudolph W. Van Norden. (Elec. Wld., Feb. 3, 1912; 4¼ pp., illus.) 20c.

18,540—HYDRO-ELECTRIC POWER for Minnesota Ranges. C. A. Tupper. (Min. and Eng. Wld., Mar. 23, 1912; 4¾ pp., illus.) 20c.

18,541—LOCOMOTIVES—Storage Battery Locomotives. (Coal Age, Feb. 3, 1912; 1 p., illus.) 20c.

18,542—POWER — The Comparative Values of Water Power and Steam Power. A. C. Dunham. (Elec. Wld., Jan. 6, 1912; 2½ pp.) 20c.

18,543—POWER PLANTS — Modern Power Plants in Florida Phosphate District. C. A. Tupper. (Min. and Eng. Wld., Feb. 3, 1912; 3¼ pp., illus.) 20c.

18,544—PUMPING PLANT at Sloss Iron Mines, Alabama. C. A. Tupper. (Eng. and Min. Journ., Mar. 16, 1912; 1⅓ pp., illus.) 20c.

18,545—PUMPS—High-Speed Turbine Pumps. J. W. Rogers. (Cassier's Mag., Mar., 1912; 9 pp., illus.) 40c.

18,546—STEAM ECONOMY—Economy in the Use of Steam. R. H. Rowland. (Mines and Minerals, Mar., 1912; 1½ pp., illus.) 40c.

18,547—STEAM POWER PLANTS. O. S. Lyford, Jr., and R. W. Stovel. (Proc. Eng. Soc., W. Penn., Jan., 1912; 54 pp., illus.) 60c.

18,548 — STEAM-SHOVEL DIPPER TRIPS Used on the Panama Canal. (Eng. News, Jan. 25, 1912; ¾ p., illus.) 20c.

SAMPLING AND ASSAYING

18,550—PLATINUM—The Direct Determination of Small Amounts of Platinum in Ores and Bullion. Frederic P. Dewey. (Advance proof, A. I. M. E., Feb., 1912; 4 pp.)

18,551—RAPID METHODS of Technical Analysis. Frank D. Aller. (Colo. School of Mines Mag., Mar., 1912; 1¼ pp.) Continuation of articles previously indexed.

18,552 — SMELTER ASSAYS — Quick Combination Methods in Smelter Assays. A. T. French. (I. M. M. Bull. 89, 1912; 18 pp.)

INDUSTRIAL CHEMISTRY

18,553—ATMOSPHERIC NITROGEN—Ausnutzung der Koksofengase zur Gewinnung von Salpetersäure aus dem Stickstoff der Luft. Dobbelstein. (Glückauf, Feb. 24, 1912; 10½ pp., illus.) Utilization of coke-oven gases for the extraction of nitric acid from the nitrogen of air. 40c.

18,554—NITROGLYCERINE — Fabrication de la Nitroglycérine. P. Lambert. (Rev. de Chimie Industrielle, Jan., 1912; 4¾ pp.) 40c.

18,555 — SULPHATE OF AMMONIA, Nitrate of Soda and Sulphate of Ammonia. (Am. Fertilizer, Feb. 10, 1912; 9 pp.) Abstract from the annual review of the nitrate of soda and sulphate of ammonia market for the year 1911, as prepared by Bradbury & Hirsch, Liverpool, Eng. Shipments and average monthly prices. 20c.

18,556 — SULPHATE OF AMMONIA, Plants for Making. C. G. Atwater. (Progressive Age, Jan. 1, 1912; 6¼ pp., illus.) 40c.

PERSONAL

Mining and metallurgical engineers are invited to keep The Engineering and Mining Journal informed of their movements and appointments.

Alexander Gray, of Porcupine, Ont., is in New York.

J. E. McAllister has gone to England on a business trip.

M. K. Rodgers, of Seattle, Wash., was in New York last week.

Wallace Broad is now on his way to the province of Hunan, China.

Henry Krumb is examining the property of the Ohio Copper Co. in Utah.

Price McKinney, of Cleveland, O., has gone to Terrazas, Chihuahua, Mexico.

Thomas R. Stevens, recently at Batum, Russia, has just returned to the United States.

Charles M. MacNeill, president of the Utah Copper Co., has been visiting the mines.

George H. Garrey, who recently returned from Mexico, has been in New York the past week.

George J. Hough has sold his business as assayer at Salida, Colo., and has gone to Zacatecas, Mexico.

Stanley C. Sears has returned from Mexico, and will be for the present at Room 104, State House, Boston.

Grant B. Schley has been visiting the Britannia, on Howe Sound, B. C., in which mine he is largely interested.

H. Parks, superintendent of the Nipissing mine, Cobalt, was in New York last week, on his way to England on a short visit.

William Hanson, of Montreal, has been elected president of the Maritime Coal, Railway & Power Co. of Nova Scotia.

Francis Drake has taken an appointment as consulting mining engineer in Rhodesia for Lewis & Marks, of London.

C. C. Forester has been appointed general manager of the Evans Consolidated Mining Co. in the Black Hills, South Dakota.

Heinrich Koppers, of Essen, Germany, inventor and builder of the Koppers by-product coke oven, is visiting the United States.

John W. Miller, at one time heavily interested in the Porcupine camp, has returned to Canada from a visit to South America.

P. Justice Grugan recently made an investigation of the iron ore deposits in Fulton County, Penn., for a steel company of Pennsylvania.

Henry Cribb, recently at Peak Hill, Western Australia, is now manager of the Tominil mine, near Guadalupe de los Reyes, Sinaloa, Mexico.

W. L. Saunders, president of the Ingersoll-Rand Co., will make the commencement address at the Colorado School of Mines, Golden, Colo.

S. F. Shaw has been appointed superintendent of the Tiro General mine of the American Smelting & Refining Co. at Charcas, San Luis Potosi, Mexico.

J. M. Callow, consulting mill engineer, for the Inspiration Copper Co., has returned to Salt Lake after four months' absence on professional work in connection with the new mill.

H. L. Brinker has been appointed assistant superintendent of blast furnaces at the Ohio works of the Carnegie Steel Co. He has been chief chemist of the plant for some time.

George O. Argall, general manager of the Iron Silver Mining Co., of Leadville, Colo., has returned from a trip to Panama. After attending the annual meeting of his company in New York he proceeded to Leadville.

Kenneth Duncan, recently connected with the Pioneer mine, has been appointed general manager of the North American Iron Co. and the Consolidated Vermillion Iron Co. operating on the Vermillion iron range in Minnesota.

O. B. McKay, of Arizona, who has been employed as superintendent of construction of the power plant installed at the Fruitvale mine, in Nevada County, California, will make an extended trip north, including Victoria, B. C., and Juneau, Alaska.

C. H. McMillan, who recently severed his connection with the Dominion Steel Corporation, will shortly accept a leading position with the Canada Cement Co. and devote his attention to the fuel question with a view of lessening the cost of production.

E. C. Hutchinson, of San Francisco, president of the Kennedy Mining Co., operating the deepest gold mine in California, in Amador County, has been appointed, by Governor Johnson, trustee of the State Mining Bureau, to occupy the place vacated by the death of Dr. Deane last year.

N. P. Turner has resigned his position as chief engineer of the Cuba R.R. In association with L. D. Moore, of New York, he will take up mining and general engineering and exploration work in the West Indies, Central and South America, with headquarters for the present at Hotel Camagüey, Camagüey, Cuba.

George Burnham, Sr., formerly head of the Baldwin Locomotive Works, Philadelphia, celebrated his 95th birthday anniversary, last week. His connection with the Baldwin Locomotive Works began as a clerk when he was 17 years of age, and he filled various capacities until he became the head of the firm at the death of Matthias Baldwin, in 1886. He retired two years ago, after having served with the company for 76 years.

Gen. Pascual Orosco, now at the head of the insurrectionary movement in northern Mexico, was at one time in charge of a burro train at Florence, Arizona. It was then believed that he was American born but this he denies. He later moved to western Chihuahua and before the Madero revolt was engaged in the transport of supplies for the American mining companies operating in that region. He was considered very energetic and responsible in this business and had very good relations with American mining men.

OBITUARY

George Hardie, one of the pioneer mining men on the Upper Peninsula of Michigan, died at Chicago, March 24. He was 88 years old, having been born in Edinburg, Scotland, in 1824. His chief interests were in Michigan copper properties, which he developed in the early fifties.

Simeon F. Sullivan died at Brooklyn, N. Y., March 29. He was for many years the confidential agent of the late Senator Calvin S. Brice of Ohio. After Senator Brice's death Mr. Sullivan became secretary and treasurer of the Chihuahua (Mexico) Mining Co. Later he established an investment company in New York.

Henry O'Sullivan, formerly provincial geologist of the province of Quebec, died at Quebec on March 27. He was a native of Ste. Catherine, Que., and graduated at Laval University in 1869. He was a fellow of the Royal Geographical Society and a recognized authority on the geology and geography of Quebec, his work including surveys of the James Bay region, the Labrador coast, Gaspé, Ungava and the Abitibi district.

Societies and Technical Schools

University of Idaho—Prof. R. S. McCaffery, head of the mining department, addressed the Associated Miners of the University at their last bi-weekly meeting Mar. 19. He gave an interesting talk on aërial tramways and illustrated with lantern slides. At this meeting the association discussed plans for its spring mining trip will probably be taken to British Columbia.

International Congress of Applied Chemistry—Announcement No. 3, containing information on the program, excursions and factory visits which have been arranged for the members of the Eighth International Congress of Applied Chemistry, to be held Sept. 4 to 13, has been sent out by the secretary, Bernhard C. Hesse, 25 Broad Street, New York. Members who desire to take part in the various tours which have been arranged are especially requested to notify the American committee as soon as possible since some of the reservations will have to be disposed of entirely before May 15. The present announcement is the last to be issued before the holding of the congress.

Editorial Correspondence

From our Representatives at Important Mining Centers

San Francisco

Mar. 27—The farmers of Shasta County are again complaining that crops are being damaged by the fumes from the Mammoth smeltery at Kennett; the farmers of Calaveras, Amador and San Joaquin Counties are still grumbling about the Campo Seco smeltery; and the state conservation commission is reported to be preparing for a campaign against the quartz mills, that will require the impounding of tailings as required of hydraulic miners. It is not believed by disinterested investigators that there is any actual damage being done to the crops or to the streams that will not be cured by the smeltery and mill operators without a shutdown. It is doubtful if the present damage is in any measure caused by smeltery smoke. The complaints come from farmers 30 miles southeast of Kennett, and the blight on the alfalfa and the alleged damage to the olive orchards extends into Glenn and Tehama Counties, entirely out of the limit of the smoke area. It is more likely to have been caused by the long, dry winter and the cold north winds, as is admitted by farmers who are not complaining. In the Campo Seco vicinity the same cause may be safely set down for much of the damage. The Mammoth company has been operating the baghouse successfully, and it is believed that there is no further actual cause for serious complaint. The Campo Seco smelter has been industriously experimenting for the last year, and the damage in that vicinity has been greatly reduced.

The reported complaint of the conservationists is a new wrinkle, and it is as surprising as it is new. The damage done to streams by the tailings from the mills, if there really is any, is so small that it is hardly worth the attention of a dignified body of men. Men of broad acquaintance with the quartz-mine operations are of this opinion. In many districts there is room for improvement and such improvement would add to the value of the land, though without direct relation to the near-by streams. In one instance in Amador County, advantage was taken of the tailings pile by a farmer, and a productive plot resulted. The leveled area was first occupied as a feeding corral; after the stock had been wintered there the ground was plowed and cultivated and produced good crops of alfalfa. A law that would require the construction of impounding dams by all quartz-mine operators that have mills in the vicinity of live streams, or a law similar to that regulating hydraulic mining would work a hardship and demand needless expenditure of large sums of money.

Butte

Mar. 27—If ore shipments to the Washoe and Great Falls smelteries continue without interruption during the remainder of March at the present rate, the production will not only exceed that of February when 27,450,000 lb. of copper were produced, but will exceed considerably the figures of any month for the last two years. In March, 1909, the smelteries of the Anaconda company turned out 27,028,728 lb. of copper, and the Clark mines, which did not then belong to the Anaconda company, produced about 1,500,000 lb., a total of 28,528,728 lb. It is estimated that this month's production of the two plants of the Anaconda company will be about 29,000,000 lb., and allowing for about 1,250,000 pounds from the East Butte and some other small companies, that the amount for the Butte district will exceed 30,000,000 lb. The Mountain View, High Ore and Badger State mines of the Anaconda, have been selected to bear the heaviest burden of this increase, although none of them are being run at their full capacity.

Preparations are being made for the electrification of the Butte, Anaconda & Pacific R.R., between Butte and Anaconda, and actual work will commence soon. Twenty-five cars of steel rails, bored for electric connections, have been placed along the right-of-way between Anaconda and Durant, and 20 cars of ties have also been unloaded. Anaconda will be headquarters for the working crew, and the work will proceed from that city toward Butte.

Denver

Mar. 29—Judge W. A. Colburn, president of the company owning the Ajax mine, on Battle Mountain, in the Cripple Creek district, is credited with the statement that the mill, recently built, is a complete success, and that a cleanup after three months' operation resulted in a retort of $14,000, from ore worth $16,000. The local paper naïvely remarks: "This demonstrates that the process is dissolving the gold." The president further states that the ore treated runs from $1.60 to $3 per ton, and that the tailings assay 80c. per ton. A statement of costs is not given.

Fifteen cement plants in Kansas and Oklahoma are parties to a merger, which was effected for the purpose of maintaining a steady price and eliminating competition, and which has closed a war of three years' duration. The result is that cement prices have advanced 20c. per bbl. in Denver, and another advance of 30c. is predicted. It is now selling in Denver at $1.37 per bbl., based on a Kansas mill price of 70 cents.

In view of the fact that the deep drainage tunnel has rendered available for working without the cost of pumping, ground about 700 ft. deep over the entire Cripple Creek district, and that rich ore has been found at the lowest levels attained by the deepest shafts, it is interesting to note from a statement compiled by the Victor *News*, that there are only 38 shafts in the entire recognized producing area, that have been sunk to a depth of 1000 feet.

Salt Lake City

Mar. 28—It is reported that the Utah Copper Co. will, during the next few months, complete the removal of a piece of overburden that has heretofore interfered with the maximum extraction of ore and that soon after midsummer it will become possible to supply the mills with 20,000 tons per day, which will mean a copper production at the rate of about 140,000,000 lb. per annum.

During February the Ohio Copper Co. treated 51,924 tons of ore, producing 1870 tons of concentrates, averaging 20.4% copper. Profits from the 757,207 lb. of copper produced were $37,117, as compared to $26,413 for November from 711,914 lb. The average daily ore treated was 1790 tons, as against 1741 tons for November. The ratio of concentration was 27.76:1, and that for November was 39.02:1. Comparing costs for the two months, in general, milling costs were lower in November, and mining and transportation charges higher. Milling costs for February, including general expenses, were 37.97c. per ton as against 34.20c. for November. February mining costs were 22.40c. per ton, and those for November, 24.03c. Transportation charges in February were 15.97c. per ton, as compared to 16.3c. in November.

A fact not generally known is that the branch office of the U. S. Geological Survey here, is open to the public, and any information regarding the survey publications or maps on the local or surrounding mining districts may always be

obtained. The office is in the Kearns Building and is in charge of Victor C. Heikes.

Deadwood, S. D.

Mar. 28—The order allowing the U. S. Assay Office here to make ore assays for $1 each, has been enlarged so that the office is authorized to make not only an ore assay for gold and silver for this price, but the following metals also are determined: Copper, lead, zinc, iron and tin. This is the only government assay office in the country at which this charge has gone into effect, and marks the first step of the federal government in doing assay work at a commercial price. Previously the price has been $3 for a gold-silver assay.

A decision, handed down at Detroit, Mich., in a suit brought by one of the stockholders of the Golden Crest company for an accounting of about $750,000, gives a verdict for the defendant, Pres. R. L. Bailie. The decision also goes farther and orders the cancellation of certain stock and notes given by the company. This clears up the company's affairs so that work will be begun this summer.

Houghton, Mich.

Mar. 29—The advance in the price of copper is particularly interesting to the mines of the Lake Superior district, for at the present price practically all the mines can make a fair profit and some will return large dividends. The Ahmeek will earn large returns at the present rate of production, and when the two new shafts are sending out their share of rock, the mine's present production will be about doubled. Calumet & Hecla will be materially affected by the rise, both through its own production and its holdings in other companies. During the last month this company produced rock from the Osceola amygdaloid lode, on its property, at a cost of $1.27 per ton, and it will, in all probability, do as well, if not a little better, in March.

Osceola Consolidated will benefit, for the North Kearsarge branch can return a good profit with copper at 15½c., while at about 12½c. per lb. it could scarcely meet expenses; the old Osceola workings can also be operated profitably, and the shafts at that mine will likely be reopened early in the summer. Tamarack should also make money, considering the present conditions at the mine.

Isle Royale is planning to increase production materially during the coming summer, although it is rumored that the proposed plan for affording additional stamp facilities for this and other companies associated with the Calumet & Hecla, is to be blocked. This would not affect the production of Isle Royale, as the management has control of other milling facilities that could handle this production.

Negaunee, Mich.

Mar. 30—The prospect for an unusually late opening of navigation on the Great Lakes is occasioning some apprehension by railway, steamship and mining interests. Usually navigation opens in April; this year due to the abnormally severe winter, it may be delayed until the middle of May. Reports differ as to the statements that in the last winter Lake Superior was frozen over for the first time in many years; it is agreed, however, that the ice for a considerable distance from shore is unusually thick and that it will be some time before the ice has left the vicinity of the Soo ship canal. The question of how much ore will be shipped is, of course, an open one; the initial feeling was that several million tons more than last year's output of 32,000,000 tons would be needed, but recent rumors of a cut in ore prices have caused some pessimism. Following the report of the cut in the price of ore have come rumors that the price of transportation from docks to lower Lake ports would be cut.

Surveyors are at work on the proposed extension of the Chicago, Milwaukee & St. Paul R.R., from Crystal Falls to Iron River. The new route will take in the Chicagon, Erickson and Rogers mines, and the Blair exploration, and it will enter Iron River near the Tully mine. No official statement has as yet been given out by the railway company that the extension will actually be built, but it is believed that an announcement will be made soon.

Chihuahua, Mexico

Mar. 25—The Liberal revolution is seriously affecting the mining industry in this and adjoining states, in fact more so than did the Madero revolution of last year. Immediate and subsequent results will be more detrimental, because lack of confidence on the part of foreign investors will be greater than during or since the previous revolution, and there is, perhaps, good ground for such an attitude.

No property destruction or personal interference with foreigners has been reported, except in isolated cases, but there is difficulty in securing supplies and in marketing products because of irregular, and, in some instances, entire absence of railroad transportation. The immediate difficulty is the shortage of dynamite, and unless this commodity is permitted to come in immediately, the majority of the mines throughout this and adjoining states will be forced to suspend operations. The supply in the Santa Eulalia camp will be exhausted in about two weeks, after which time all the mines will probably shut down indefinitely, throwing over 3000 peon laborers out of employment, the majority of whom will presumably take up arms in the Liberal or Orozco cause. The few mines operating in the western part of the state, as well as in the vicinity of Parral, Santa Barbara and Naica, are in the same dilemma, with the additional difficulty of running low on cyanide and other mine supplies.

The Sierra Mining Co., operating at Ocampo, closed down about Mar. 15, as did several smaller mines in the same camp. The Yoquivo Development Co. is still in operation, as are the Dolores, Batopilas and Republica companies, but it is likely that the last two, as well as the Yoquivo, will be forced to suspend soon. The Dolores company has sufficient supplies to continue for at least two months. The El Rayo, at Santa Barbara, as well as the Creston-Colorado and La Dura mines, in Sonora, report sufficient supplies for at least two months.

The American Smelting & Refining Co.'s smeltery, at Chihuahua, continues in uninterrupted commission, and has had its entire five furnaces in blast since Mar. 15, smelting a larger tonnage than ever before. Sufficient coke and coal have been secured for three months, and if the Santa Eulalia ore supply can be maintained, the plant can continue for a long time. The Asarco plant has practically suspended operations, but the Aguascalientes works are operating steadily, and will continue to do so as long as communication over the San Luis Potosi division of the National Railways of Mexico is kept open. The Torreon smeltery is operating at small capacity, but with the exhaustion of its accumulated ore and fuel supplies, will have to close down, as railroad communication to the coal fields and ore-supply centers has been cut off for several weeks. The ore-buying agencies at both Parral and Chihuahua have discontinued ore receipts, and this has caused the shutting down of many smaller mines. Operations have continued almost uninterruptedly in the Guanacevi camp, but the Inde camp is shut down for an indefinite period. At Guadalupe y Calvo, operations are under way on a small scale.

Another perplexing problem for the mining men in this state just now is the payment of mine taxes, falling due not later than Apr. 1. A large portion of the mining area is now under the control of the rebel factions. In many districts there are officials representing the constitutional government and in others the officials appointed by the rebel leader are collecting taxes. In some cases the companies have sent their taxes direct to the Department of Hacienda, at Mexico City, which is permissable, and others have deposited the money with the American Consuls or the American Ambassador, and notified the officials. It is certain that serious complications will arise under the extraordinary conditions of political affairs which now prevail in Mexico.

The Mining News

The Current History of Mining

Alaska

Horner & Co. are installing a large hydraulic plant on Eva Creek, where the ground, it is said, will average $5 per foot.

Isabella—Some rich gravel has been found on these claims on Vault Creek, in the Fairbanks district. Conta & Co. have charge.

Ramsey-Rutherford — This property, near Valdez, is being developed by Col. B. F. Millard and associates, and is showing some good ore.

Arizona

Gila County

Live Oak—The work of enlarging No. 2 shaft has been completed. The third compartment was added by raising from three different points and the total distance of 925 ft. was accomplished in 40 days. Sinking will be resumed soon, and it is intended to sink to 1250 ft. Meanwhile, the new steel headframe will be erected and the new hoisting equipment installed. The new Ingersoll-Rand 1300-cu.ft. compressor is being erected.

Barney—Hole No. 1 has been discontinued at 1450 ft. depth, being the deepest hole ever drilled in the district. It is bottomed in schist and is a flowing well, the strong flow of water encountered in the dacite formation at 960 ft., continuing undiminished and sufficient for both churn-drilling and domestic use. Hole No. 3 will be started at once. Hole No. 2 is 370 ft. deep.

Miami—Development work totals about 6000 ft. per month. All mining is being done above the 420-ft. level, but the 570-ft. level is being opened up. Near the mill, pits are being made for foundations for a tailing tower. It will be equipped with four bucket elevators, having 24-in. belts and designed to elevate the tailings 60 ft., so that the gulch into which they are now being run, may be entirely filled. This elevation will also be sufficient to run the tailings by gravity into the next gulch to the east.

South Live Oak—Harry Millard, who will have charge of churn-drilling, has returned from St. Louis, where he purchased a large machine, especially designed for deep drilling. It is expected to arrive in about six weeks.

Arizona Commercial—A syndicate, composed of banking interests closely connected with the reorganization committee, has purchased $113,000 bonds from Hayden, Stone & Co., and Paine, Webber & Co., and will deposit them. This assures the success of the reorganization plan. The new company will be named the Arizona Commercial Mining Co., and will be formed under Maine laws, with 300,000 shares and $5 par value.

Southwestern Miami—Drilling has been resumed in hole No. 2. It is reported that both this hole and more recently No. 3 hole, have found ore, but we have been unable to confirm this.

Maricopa County

Development is underway on some silver-lead prospects of the well known Bronco vein belt, in the Seven Springs district.

Maricopa—A tunnel is being driven at this mine to cut the old workings at about 150 ft. in depth.

Magazine—Some rich copper ore, with native gold, has been found in this prospect, about 40 miles north of Phoenix, beyond the Cave Creek district.

Grande Traverse—Operations on this and the Oriental copper properties, near Gold Hill, have entirely closed.

Mormon Girl—Work will be resumed soon on this property near Cave Creek station. The openings are 400 ft. deep.

Nicholson—In the Gold Hill camp, 35 miles north of Phœnix, leasers are treating the surface ore from this property in the Dravo mill.

Dugas — This mine adjoining the Nicholson has been recently examined for eastern interests.

Bondurant—This mine in the Cave Creek district, north of Phœnix, has been equipped with a 10-stamp mill and will operate.

Phoenix—An investigation of the old mine has been made recently for the eastern owners. The mine at one time had a 60-stamp mill, now partly removed. W. H. Channel has recently made some tests of the vanadium ore in the mine.

Pima County

Oceanic—This gold mine at Arivaca, owned by H. R. Bacon, is under bond to Marion E. Ish, Walter E. Jelsky and S. J. Shoemaker, of Los Angeles. A cyanide plant has been installed and is being operated on a small scale. Development is being done.

California

Calaveras County

Melones—The rich ore reported to have been found recently is melonite, the same as was taken from the old workings several years ago. The ore-shoot is about 11 ft. wide, averages about $20 per ton, and is in the south drift of the 1350-ft. level, the latter being 250 ft. below the main tunnel.

Inyo County

Skidoo—During February, 1350 tons of ore were milled, yielding $11,602 gross and net $3078. Operating expenses were $7860 and $863 were expended on development.

Placer County

Eldorado & Placer Mining & Power Co.—Lumber for hull construction is being hauled to Butcher Ranch for the new dredge to be installed on the middle fork of American River, 20 miles east of Auburn. Alfred Tregidgo, Foxcroft Building, San Francisco, is president, and George L. Holmes is engineer.

Santa Barbara County

Palmer Union Oil Co.—Announcement has been made of the sale of this company's properties to the Imperial Foreign Corporation, of London. This marks the termination of negotiations extending over a period of two years.

Sacramento County

Natomas Consolidated — No. 10, the new steel-hull dredge, designed for installation at Rebel Hill in the American River district near Natoma, is in course of construction. The steel hull, built by Johnston Bros., Ferrysburg, Mich., for the Yuba Construction Co., is *en route*. The hull was put together at the Michigan works, and knocked down for shipment. The buckets will be of 15-cu.ft. capacity; the latter with other machinery is from the Yuba Construction Co. shops, at Marysville. The rebuilding of No. 8, the dredge that was burned last October, will begin as soon as the new steel hull is completed. These boats will be in commission this year.

Sierra County

Mountain—This property, at Sierra City, is reported to have been bonded to Denver men.

Rosasco—The tunnel being driven to cut the vein on the serpentine contact, is nearing the intersection point. This prop-

erty is being worked under bond to C. A. Austin and associates of Sunnyvale, Cal. H. F. Whirlow, of Berkeley, is superintendent.

Telegraph—Rich gravel is being taken out and the quartz mill will be rebuilt this season and used in crushing the high-grade ore recently found. The quartz lies along the Mountain House-Goodyear Bar serpentine belt, which reaches the Kate Hardy mine on the south. Hon. J. W. Finney is manager.

Colorado

Boulder County

Tungsten Mountain Mines Co.—The mill, near Nederland, has been enlarged to a capacity of 30 tons per day of crude ore, and is now in operation and producing high-grade concentrates. It is stated that the company's tunnel is being pushed ahead rapidly with machine drills, and that a year's supply of ore is in sight.

Clear Creek County

It is reported from Idaho Springs that H. B. Clifford and associates, of New York, who are credited with purchasing the Waldorf mines in the Argentine district, and other properties on Seaton Mountain, will construct a large mill. It is also stated that last summer they sent two cars of ore to Thomas A. Edison for test purposes.

West Griffith—W. O. Robinson, of Georgetown, has taken a five years' bond and lease on this mine, and has started work.

Josephine—This mine, in West Argentine, has been sold for $7500 by the referee in bankruptcy, Fermor J. Spencer, to J. C. Bell.

Capital—This mine, under the Hummer lease, is shipping $60 ore, and also a good tonnage of ore to the company mill. The ore carries galena and copper.

Cripple Creek District

El Paso—A good orebody has been opened for 40 ft. in the first level. Assayed samples of the first car of screenings indicate 3 oz. gold per ton. The shaft from the deep drainage tunnel level will be completed soon.

Dante—Two cars of 1-oz. gold ore from the Gaylord lease will be shipped this month. About 500 ft., in depth, of stoping ground have been opened in this orebody.

Golden Cycle—It has been officially announced that the capacity of the mill is to be increased to 1200 tons, following the blowing in of the ninth Edwards roaster.

Stratton's Independence—During February, production amounted to 2766 tons, averaging $19.13 per ton. Low-grade mine and dump ore milled totaled 8700 tons. Net working profit at mine and mill was $17,800, and $1500 were expended on special development.

Wild Horse—The cyanide mill is treating 40 tons per day of low-grade ore, from the development underway by the United Gold Mines Company.

Lake County—Leadville

Little Pittsburgh—Fred Hoffer, lessee, is reported to have discovered a streak of zinc-carbonate ore, assaying about 40% zinc, 90 ft. north of the old shaft. High-grade lead carbonate was formerly taken from this mine.

Dinero—About 200 tons of ore per month are going to the smeltery from this tunnel in Sugar Loaf Mountain.

American Extraction Co.—About 500 tons per month, from the dump of this company, are being shipped to the Arkansas Valley plant, and 300 tons to Pueblo.

Mt. Champion—The machinery for the new 75-ton mill for this mine is on the ground and will be installed soon. The equipment consists of crushers, rolls, tube mill and tables.

Ouray County

Revenue—This mine, in the Sneffles district, has been operated for over 30 years, and produced about $12,000,000 gross, under the general management of A. E. Reynolds, of Denver. Lessee Platt is now operating it. Superintendent Camp has charge of 12 men, who are cleaning up the workings preparatory to the summer's work.

Idaho

Boise County

Gold Hill & Iowa—This mine, at Quartzburg, continues to stope ore from the 500 level, and the mill is running at full capacity. E. E. Carter is manager.

Elkhorn—E. Fitzhugh, manager, states that good ore has been found and that milling will start as soon as the weather permits.

Coeur d'Alene District

Lucky Calumet—The new compressor is now in operation and is giving good results. Progress now is more rapid than formerly, when hand work was necessary. Air is also being supplied from the new compressor to the Snowshoe mine.

Stewart—An electric-haulage system has been installed in the new lower tunnel and the gravity tram, connecting the lower tunnel with the railroad, is about completed.

Tamarack—The litigation which has been holding up operations at this property for several years has been settled, and the mine will be worked soon. The work already done has developed an orebody which can be mined and milled without delay. The orebody is in the same fault as the Hercules orebody, and is a high-grade, lead-silver deposit.

Lemhi County

A crew is prospecting Girtson Creek, with shafts, to determine if dredging is warranted. The dredge on Kirtley Creek has had no trouble working this winter, and reports a successful season.

The Gilmore district has been active all winter, and has been shipping from three to five cars of ore per day to Salt Lake smelteries.

Kittie Burton—This mine, at Ulysses, has employed a good-sized force of men all winter, and has maintained steady shipments of concentrates.

Carmen Creek—This company has completed a 20-ton mill on its property, at Carmen Creek. Equipment includes a Lane, slow-feed, chilean mill and a Ludwic concentrating table. Power is supplied by a 36-in. Pelton water wheel under a 100-ft. head. Operations will start as soon as the snow goes. J. W. F. Halcombe is manager.

Kansas

Ozark Smelting & Mining Co.—This company will add another block of oxide furnaces to its works at Coffeyville.

Michigan

Copper

Godfrey M. Hyams, of Boston, connected with the former Bigelow Syndicate mines, has secured in the Federal Court, at Grand Rapids, Mich., a temporary order, restraining the carrying out of the milling plans proposed recently by the Calumet & Hecla company. Isle Royale is restrained from contracting with the Lake Milling, Smelting & Refining Co., or with the Superior company for hauling Superior rock. Calumet & Hecla is restrained from voting Isle Royale and Tamarack shares at the annual meetings, as regards the proposed milling scheme. The Tamarack company is also restrained from taking any action at its annual meeting, in this connection.

Hancock—Streaks of copper have again appeared in the vertical shaft and results are being awaited with interest.

Superior—This company has tapped the West lode at various levels, by drilling, and at all points has found it to be well mineralized; it will probably soon be opened by crosscuts and drifts.

Michigan—It is likely that this property will resume operations during the early summer, owing to the price of the metal. Considerable work has been done on the Calico and Branch lodes, but the ground is low grade. An exploratory campaign will probably be carried on in the Evergreen group of lodes.

Lake—The return from the second week of the mill run has shown about 25.90 lb. of mineral per ton of rock

stamped, which is a material improvement over the run for the first week. Rock shipments are being made to the Trimountain mill of the Copper Range Consolidated Company.

Indiana—The total expense for 1911 was $82,083, of which drilling constituted $11,946, shaft sinking, $24,840, and construction, $24,855. Accounts payable were $41,966. On Jan. 1, 1912, the shaft was 533 ft. deep and advancing 75 ft. per month. Plats will be cut at the 600- and 1000-ft. levels, and some drifting done. T. H. Bennett is in charge.

Contact—The report for 1911 shows balance on hand, Jan. 1, 1912, $20,462. Since that time, $24,370 have been received from subscription under the plan of exchange with the Elm River Copper Co. A horizontal width of 4900 ft. has been disclosed by drilling, and No. 10 hole showed copper in places.

Iron

The Stephenson lumbering interests, controlled by Senator Stephenson, have joined with Marquette men to erect a charcoal-iron blast furnace, at Wells, Mich. John R. Van Evera, Austin Farrel, head of the Cleveland-Cliffs Iron Co. furnace department, and Charles Schaffer, all of Marquette, are interested; the last named is managing director. Charcoal will be furnished from the Stephenson plants.

Rolling Mill—Work at the new No. 2 shaft is progressing rapidly. The 8x8-ft. raise, which was holed through to surface from the 620-ft. level, is being enlarged to 12x14-ft. size, and timbered with Washington fir. This work of enlarging the shaft is progressing from the top down, and more than 110 ft. have been finished. The same "stoper," air-feed, hammer drills, which were used in the raise, are being used in the slicing work now being done, by putting in 45° holes from below for a 5-ft. cut. A temporary headframe and puffer are installed on surface for lowering tools, men and timber, but the rock is hoisted through No. 1 shaft.

Hoose Mining Co.—This new corporation, composed of Iron Mountain men, is to operate in the Iron River district. An option has been taken on the Boyington farm, north of Iron River, near the Bates mine. This tract was partially diamond-drilled several years ago; more holes will be drilled on other portions of the property.

Winter-Vermillion Iron Co.—Work has been discontinued on this company's holdings, two miles east of Negaunee, which were being diamond-drilled by W. T. McCarthy.

Norman Iron Co.—On this 320-acre tract, northwest of Republic, the Jones & Laughlin Co., which is diamond-drilling under option, has put down several deep angle holes, pointing east. The two drills have been moved to the west and vertical holes will be sunk.

Minnesota

Mesabi Range

Morton—This mine, operated by the Todd-Stambaugh company, will make its initial shipment this year. It is an underground mine, one of the deepest in the district, the shaft having been sunk by the New York Foundation Co., last year.

Longyear—This Jones & Laughlin mine will become a shipper this season. Butler Brothers, who have the contract for the stripping, will load the ore for the mining company this season.

Buffalo & Susquehanna—The Winston-Dear company, that has the stripping contract, will mine the ore for the company this year; the Rogers-Brown Ore Co. will not put in its own mining equipment until next season.

Stevenson—This mine, which was closed down on account of a strike recently, will ship ore from the pit and the stockpile. The shaft will remain boarded up until a settlement has been reached. The property is operated by the Corrigan-McKinney Co. It is generally understood that the strike was caused by a disagreement on the rate of pay for 8-hour shifts.

Missouri

Katy Lou—This Chitwood Hollow property, in the Joplin district, has been sold to the Cripple River Hydraulic Mining Co., of New York, J. B. Shale, president. It comprises about nine acres, and has a mill. It will be operated as heretofore.

Montana

Butte District

Anaconda—The station on the 1600-ft. level of the Badger State mine is being enlarged to 20x50 ft., to handle increased production. This station is being timbered with 14x14-in. posts and caps, the sets being 12 ft. high. The 1800-ft. level station is also being enlarged. All ore in the Badger State mine is trammed to the shaft by the miners, as the workings as yet are not far from the shaft. All of the levels have been laid with heavy steel, however, and it is the intention to equip the mine with electric motors soon. The Emily shaft, 500 ft. northeast of the main shaft, is to be used as an air shaft. Sinking is approaching the 600-ft. level. The first station cut was the 340-ft., and from here one crosscut has been driven south over 100 ft., and another north about 300 ft. A pump station has been cut on the 540-ft. level, and a pump, operated by compressed air, has been installed.

Rex—George Carter and James Ducy, who have been operating this group of claims in Tramway Gulch, four miles east of Butte, have opened a 10-ft. vein, carrying copper, silver and gold.

Jefferson County

Corbin Copper—The Bonanza tunnel recently encountered the north vein, and 40 ft. of drifting have been done. The vein that was developed on the Dewey claim has been cut 50 ft. west of the Bonanza tunnel, and drifted on for 65 ft., showing silver-bearing quartz. Stoping and sinking are in progress in the Rosalie claim; the shaft has been sunk 22 ft. on the foot wall, and shows copper and silver ore in the bottom. About 10 tons of ore per day are being sent to the East Helena smeltery. The Dow tunnel is being driven south about 5 ft. per day to intersect the Minah vein.

Lincoln County

Libby Mining Co.—This and the Comet Mining Co. operating placer mines on Libby Creek, have been closed down during the winter, as it is impossible to work there at this season. They were operated steadily last summer and the work will probably be continued soon. P. J. Brophy, of Butte, is president and manager of both companies, which control about 1000 acres of placer ground.

Madison County

Preparations are being made to resume placer mining in Alder Gulch; if the present warm weather continues, work will commence soon, as there is plenty of water and the frost is leaving the ground.

Missoula County

King & Queen—A complaint has been filed with the state board of railroad commissioners, at Helena, by this Pittsburg company, operating claims near Ashmore, attacking the rate on ore from the mines to the East Helena smeltery. It is stated that the total distance is 333 miles, and the rate $2.95 per ton. The complaint asks that the transfer point be changed, thus reducing the distance, and that an equitable rate be made.

Nevada

Clark County

Operations in the copper-gold area, about four miles northeast of Searchlight, have ceased entirely for the present. Several shallow shafts have been sunk on the Philadelphia-Searchlight and the adjoining Jupiter property. Another adjacent property, now closed, is the Gold Beam Consolidated. Work was commenced on the group in 1906 and more than $250,000 have been spent in exploration. The Lenape has recently been examined by an engineer for its eastern owners.

Duplex Extension—This property, adjoining the Duplex at Searchlight, has been acquired by Carlson & Lund and development by a shaft has been commenced.

Pompeii—Sinking has been resumed at this mine, north of Searchlight, on a newly discovered orebody. It is proposed soon to install a cyanide annex to the mill. W. B. Rulon is president and John R. Mendenhall is superintendent.

COMSTOCK LODE

Ward—The advance of the north drainage drift on the 2450-ft. level continues to open an extensive hot-water belt, from which a large flow of water is being obtained, the temperature of which is 170° F. It has been necessary to "snow-shed" the drift to protect the men from the scalding water. It is claimed that since this water was first tapped, it has had the effect of lowering the water 3 ft. at the Combination shaft, about 1000 ft. to the east.

C. & C.—Three of the new centrifugal pumps have been lowered to the new 2310 station. They are being set on their foundations and the electrical and discharge connections made.

ESMERALDA COUNTY

Goldfield Consolidated—The estimated March production was 30,132 tons; gross recovery, $685,000; operating expenses, $200,000, and $485,000 net realization.

NYE COUNTY

Shipments from Tonopah mines to date and for the week ended Mar. 21, are as follows:

Mines	Week	Year to Date
Tonopah Mining	3,350	39,619
Tonopah-Belmont	2,250	26,626
Montana-Tonopah	1,029	11,857
Tonopah Extension	1,085	10,902
West End	713	8,299
Midway	.....	180
MacNamara	440	3,307
North Star	.....	40
Totals	8,867	100,830
Estimated value	$221,675	.....

Tonopah-Halifax—The most important development in the district recently has been the cutting of a vein at a depth of 1010 ft. on this property. The mine adjoins the Tonopah-Belmont on the east and the shaft has been sunk to cut the eastern extension of the Belmont vein. The vein cut this week is 8 ft. wide, assaying from $8 to $90 per ton, but is another parallel vein, the Belmont vein being probably 100 ft. deeper. Half of the property is owned by Thomas Kearns, of Salt Lake City, and the other half by the West End Consolidated Mining Co., of Tonopah.

Tonopah-Belmont—During the quarter ended Feb. 29, total receipts were $897,814; expenses, $437,669; net earnings, $460,145; miscellaneous income, $15,031; total net income, $475,176. Available resources on Feb. 29 were $1,293,493, and there were $926,548 cash in banks.

West End—A 10-in. streak of high-grade ore has been opened in an orebody 10 ft. wide, averaging $40 per ton, in the west drift on No. 5 level.

New Mexico

GRANT COUNTY

Monte Rico—This company is developing a copper property at Lee's Peak, near Lordsburg. Lawrence R. Boyd, of Washington, Penn., is in charge. An adjoining property, is also under development.

SIERRA COUNTY

Vanadium Mines Co.—This Pittsburg company, A. B. Bement, receiver, is planning to resume operations at its vanadinite property, at Cutter. The mine is down 400 ft. and is extensively developed. A mill is erected, the treatment scheme of which will be radically modified to meet the results of recent metallurgical tests on the ore.

SOCORRO COUNTY

Socorro—The new De La Vergne oil engines are effecting a saving of $7000 per month. The 3-compartment, vertical shaft is 750 ft. deep and has been cutting through the vein from 730 ft. Drifting has advanced a total of 950 ft. on the seventh level, and 700 ft. have been in ore. One-half of the ore for the mill is mined in the lower levels.

South Dakota

BLACK HILLS DISTRICT

Black Hills Smelting Co.—At the annual meeting the following directors were elected: H. C. Osterman, president; Frank Czerwenka, vice-president; W. E. Tagney, secretary and treasurer; Charles Greve and R. N. Ogden. A superintendent has been engaged to succeed Paul Danckwardt, and he is expected to arrive soon.

Utah

JUAB COUNTY

Tintic shipments for the week ended Mar. 22 were 173 cars.

Beck Tunnel—The ore recently discovered in a raise from the 175-ft. level of No. 2 shaft is being followed south, and 4 ft. of shipping ore have been opened in a drift. Shipments for the month to Mar. 14 are 10 cars, a part coming from the new discovery.

Swansea—Drifting north is being continued on the 940-ft. level, and ore is still in the face. A crosscut west has been started from the north drift, and work to the east is planned.

Scranton—Lead ore, running 25% lead and 3 oz. silver, was opened six months ago in this mine, hitherto known as a producer of zinc ores. The monthly output of lead and silver ore has been 1000 tons until recently, when the output was reduced on account of the lower price for lead. The ore, from 1 to 6 ft. thick, occurs as a replacement of limestone along a strong north and south fissure, which has been followed for 1000 feet.

Chief Consolidated—Net earnings for February were $56,000; one car of ore brought smeltery returns of $10,776. The north extension of the Eagle vein has been developed from the 100-ft. level.

SALT LAKE COUNTY

Utah Consolidated—The February production is given as 16,000 tons, exceeding the monthly average of 1911 by 2000 tons; 1500 tons of lead ore were also shipped. The shaft has been sunk to the 1100-ft. level.

Utah Copper—The February production was 8,612,729 lb., being about the same as that for January.

Utah Apex—Gross receipts from ore for the six months ended Feb. 29 were $302,220; mining, smelting, freight and development expenses were $186,524. The mining profit was $115,696, and $100,000 net profit.

Thompson-Quincy—The new ore opened above the main working level is being followed toward the limestone-quartzite contact. A station is being cut at the 280-ft. level, and when this is completed, raising will be continued. The fissure carries high-grade silver-lead ore, and about 10 tons have been mined in doing this work.

SUMMIT COUNTY

Ontario—This property is being worked by the Crowther Leasing Co. It is reported that the old mill will be remodeled and put into commission June 1.

Daly West—First-class ore from and below the 1200 is being shipped. The mill has closed down temporarily, and milling ore is being developed on the lower levels.

TOOELE COUNTY

Construction has begun on the St. John & Ophir R.R., the new branch line between the Salt Lake Route and Ophir.

Ophir Hill—A considerable tonnage of concentrates is awaiting the completion of the St. John & Ophir R.R. The capacity of the mill is being increased, and the 3000-ft. tunnel has been completed. The ore carries copper, lead and silver, yielding concentrates with copper in excess of lead.

Cliff—Ore has been opened in a winze below the lower tunnel level. The present daily output of 50 tons will probably be increased when the new railroad is in operation.

Washington

White Elephant—A car of machinery has been received at this gold mine near Orient, and will be installed.

Yankee Girl—The tunnel at this mine in Ferry County is now in 245 ft. in good ore. An air compressor is to be installed.

Republic—The Rathbon Reduction Co., of Republic, has renewed a lease for two years on this property in Ferry County, and will install crushing machinery.

Wisconsin

Zinc-Lead District

Stark—A drilling company has been organized at Platteville to prospect this land adjoining the Kohinoor Blende lease.

Dugdale—Joseph Piquett and associates are assembling a hoist and pumping equipment to develop this land, three miles east of Platteville.

Gardner—Chicago men have leased this land one mile south of Platteville and will prospect by drilling.

Wyoming

Wyoming-Ervay Oil Co.—This company has been organized to operate in the Rattlesnake and Dutton Basins, Fremont and Natrona Counties. It is proposed to build a pipe line to the railroad, a distance of 12 miles. W. W. Hurt is president and J. M. Foote, Newark, N. J., is secretary.

Canada

British Columbia

Hedley—During three months, ended Mar. 31, this company milled between 15,000 and 16,000 tons of ore. Average assay value in March was $12.18, as compared with $10.70 per ton for January. Net profit for January and February was $43,311. Profits for March are estimated at about $26,000.

Ontario

A syndicate of Rochester, N. Y., men, has taken an option on six claims, owned by Lindsay and McCluskey, near Night Hawk Lake.

Gold Moose—A depth of 85 ft. has been reached at this property, in the Manitou gold district area. The vein, which carries gold ore, has widened to over 4 ft. A. R. Hutchinson is in charge.

Good Luck—Two shafts are being put down on this property, in the Manitou gold district, the combined depth being 125 ft. A good showing of ore has been found.

Connely—J. H. Curley reports that he has opened a large body of white talc in a 7x14-ft. shaft, 38 ft. deep. This property is at Madoc and adjoins the Henderson mine, the latter being about 250 ft. from the shaft mentioned above.

Ontario—Cobalt

McKinley-Darragh—The annual report shows net profits of $916,865, while the amount paid to shareholders was $1,011,461. The cash balance on hand was $198,633. The production of silver was 2,634,006 oz., a reduction of about 20,000 oz., compared with 1910. The cost of production was 19c. per oz. The ore reserves were estimated at 5,561,780 ounces.

Cobalt Lake—Production is estimated at 40,000 oz. per month, all from mill concentrates. Most of the ore supplying the mill comes from an extension of No. 4 vein, about 15 ft. above the 280-ft. level. The vein here runs 2 to 3 in. wide of 2000-oz. ore.

Nipissing—Deep exploration work is being undertaken. At No. 64 shaft an exploration shaft is being put down to 450 ft. It has already been sunk 275 ft., which is 75 ft. below the contact with the Keewatin. When it has reached a depth of 200 ft. in the Keewatin, crosscuts will be run.

Ontario—Porcupine

Moneta—The main shaft is being sunk to 175 ft., from which point considerable diamond drilling will be done.

Rea—Diamond-drill holes are being bored from the 400-ft. level, in an effort to find the oreshoot. The mine has not been closed down, as reported. It is stated that at the 400-ft. level, the crosscut has been pushed 80 ft. without definite results.

McIntyre—The mill, which was closed temporarily on account of power shortage, has been able to resume operations with a supply from the Porcupine Power Co. Pres. Albert Freeman has deposited in the bank a gold brick of 160 oz., worth approximately $3000, the result of the first cleanup after a run of 174 hours. He states that the company is making a recovery of 75% on the plates, and the tailings, which are assayed every two hours, show an average of 58c. The mill is now treating 60 tons per day.

Hollinger—The mill is expected to be ready for operation about May 1. The stamps are placed and the heavy machinery is ready for power. Two hundred men are working day and night on construction. The orebody being opened in the winze from the drift at the 200-ft. level is showing up well.

Dome—The mill has been operating under difficulties, though at one time all the batteries were in motion for a 6-hour run.

Jupiter—The final payment on the property has been made by the company. The total purchase money was $300,000 and $125,000 have been spent on plant and development. The 11-ft. vein, which showed good gold content on the upper levels, has been picked up in a crosscut on the 200-ft. level.

Dobie—This property has been closed down. D. Lorne McGibbon and his associates, who are heavily interested in the property, have placed in the treasury the title to 17 patented claims owned by them. There are $50,000 cash in the treasury. The claims will be developed.

Porcupine Kendall—Work is to be started on this property. Considerable diamond-drilling will be done.

Mexico

Chihuahua

Northern Mexico Power Co.—This company owning concessions on the Conchos River, under which it is proposed to build a dam for hydro-electric power, to supply the mining camps of Chihuahua, Parral and vicinity, has just held an important meeting in Montreal, at which matters looking to a change in the company's plans were considered. Owing to the necessity of securing a market for its power the company decided in December to secure some mining property in the Parral and adjacent camps and extensive options were taken through Paul Ginther, on which about $250,000 were advanced. This program has been criticised by some of the stockholders and it is understood that an investigation of the plan will be undertaken.

Durango

National Mines & Smelters Co.—This Pittsburg company, successor to the Lustre company, is carrying on extensive development at the properties at Magistral, under the direction of Clawson & Gillingham, mining engineers of Los Angeles, Calif. Recent work has opened a body of sulphide ore running about $10 in gold and copper. Work is now being done on the sixth level and it is intended to continue to the 1000-ft. level before making any output. The property is extensively equipped and has a smeltery on the ground; at one time this was operated as a pyritic plant. William L. Curry, vice-president, and a party of the officials recently made a trip to the mine. Present work at the mine is reported to be hampered seriously by interference with the supplies by the insurrectionists. S. H. McKee, of Pittsburg, is president.

Guerrero

Las Truchas—This iron-ore deposit at the mouth of the River Balsas has recently been examined for New York interests having an option on it. The ore is hematite and the tonnage has been estimated as high as 400,000,000 tons. There has been no development but the ore is exposed over a large area, capping a group of hills flanking the river valley near the Pacific Coast. The deposit is owned by Mexico City and Pittsburg men.

Sonora

A new copper district near Bacanora, district of Sahuaripa, is attracting notice. It was discovered about a year ago but has only recently received general attention. Extensive locations have been made by W. M. Asher and by others supposed to represent some of the large southwestern copper interests. The deposit is a sort of blanket formation and runs from 3 to 5% copper, according to report. The deposit is about five miles from the Yaqui River, in Los Moros Cañon.

The Market Report

Current Prices of the Metals, Minerals, Coal and Mining Stocks

Coal Trade Review

New York, April 3—Everything at present rests on the strike situation, which can only be summed up very briefly.

In the anthracite region work is entirely suspended, the collieries being closed almost without exception. Negotiations are not closed, however, and another conference between operators and miners is to be held April 10. Whatever proposition is then made will be submitted to a district convention of the union, so that there will be a suspension for some time, even if a compromise is effected at the conference.

In the bituminous field the joint committee last week agreed upon a compromise, by which the miners will receive an advance of 5c. a ton on lump coal, or 3c. on run-of-mine, and an advance of 5.26% will be made on day wages. This is now being voted on by the miners. If they vote to accept, the district scales will have to be adjusted. Meantime there is no strike, but most of the mines are closed, and will probably remain so for about 20 days. The probabilities are that the settlement will be accepted.

The H. C. Frick Coke Co., in the Connellsville coke region, has made an advance of 7.5% in mining wages. This will probably be followed by the smaller companies in the district.

In Great Britain the strike is still on. The question of accepting the minimum wage act passed by parliament has been submitted to a referendum vote of the miners, and the result is still in doubt.

Imports of coal into the United States, two months ended Feb. 29, long tons: Anthracite, 25; bituminous, 243,709; total, 243,734 tons, against 277,498 in 1911, showing a decrease of 33,764 tons, or 12.2%. Imports of coke were 23,503 tons in 1911, and 14,103 in 1912; a decrease of 9400 tons.

Exports of coal from the United States, two months ended Feb. 29, in long tons: Anthracite, 453,538; bituminous, 1,362,918; bituminous furnished to steamships in foreign trade, 1,080,866; total, 2,897,322 tons. The total in 1911 was 2,912,934 tons, showing a decrease of 15,662 tons, or 0.5% this year. Exports of coke for the two months were 181,027 tons in 1911, and 112,650 in 1912; a decrease of 68,377 tons, chiefly in shipments to Canada.

Coal and coke tonnage of Pennsylvania R.R. line east of Pittsburg and Erie, two months ended Feb. 29, short tons:

	1911	1912	Changes
Anthracite	1,938,093	2,147,761	I. 209,668
Bituminous	6,594,138	7,668,282	I. 1,074,144
Coke	1,683,771	1,964,184	I. 280,413
Total	10,216,002	11,780,227	I. 1,564,225

French Coal Trade—Imports of fuel in France for the year 1911 were, in metric tons: Coal, 16,230,703; coke, 2,319,591; briquettes, 1,189,326; total, 19,739,620 tons, an increase of 1,593,748 tons over 1910. Exports for 1911 were: Coal, 1,335,195; coke, 184,416; briquettes, 114,495; total, 1,634,106 tons, an increase of 54,972 tons.

Iron Trade Review

New York, Apr. 3—The iron and steel markets have generally maintained a good degree of activity. A gradual but slow bringing up of prices is reported.

In finished material, structural steel is again becoming a prominent feature, though it is the slowest to show any betterment in prices. The large fabricating companies are still taking contracts at low prices. Other lines report good business and a disposition to extend contracts further than has been the case.

Pig iron has been active, with large sales of foundry iron in Eastern territory; while basic pig is selling well also, both in the East and West. Contracts for second half are being discussed, but buyers are unwilling to pay more, in view of the reduction in Lake ore prices; while sellers are disposed to ask advances. These differences of opinion may not be adjusted without a good deal of discussion and delay. Southern iron is again being pushed, especially in seaboard territory.

The total tonnage of rails rolled in 1911 was 2,822,790 tons; a decrease of 813,241 tons, or 22.3%, from 1910. There was a very large increase in the proportion of openhearth-steel rails.

Reports from Philadelphia are that the Pennsylvania R. R. and the Reading companies have decided to sell their large interests in the Pennsylvania and the Cambria steel companies, as they consider it no longer advantageous to hold control of manufacturing companies.

The United States Steel Corporation has found it expedient to raise some $30,000,000 for new work and for working capital. The official statement says: "As authorized by unanimous vote of directors, not including any member of the firm hereafter mentioned, the Steel Corporation has sold to J. P. Morgan & Co. $30,500,000 bonds on a basis of 5.1% rate of interest. The amount will include $15,000,000, secured on Indiana Steel Co.'s plant, at Gary, Ind., $10,000,000 on Lorain Steel plant, at Lorain, Ohio, and $5,500,000 debentures of Illinois Steel Co., being part of an issue heretofore authorized. As there must be expended during 1912 about $20,000,000 for extensions of properties generally heretofore authorized, and as about $17,000,000 additional working capital is needed in consequence of increased business of companies, particularly in ore department, it has been thought advisable to secure the sum named by sale of bonds in order to keep amount of cash on hand up to the sum shown at beginning of calendar year. In view of the fact that very large sums have heretofore been appropriated from net earnings, for capital expenditures it has been decided to finance some of the capital expenditures as above stated."

Baltimore

April 1—Exports for the week included 113,280 lb. steel plates and 114,780 lb. steel billets to Glasgow, Scotland. Imports included 6400 tons iron from Cuba.

Birmingham

April 1—The present month promises to be an interesting one with the Southern pig-iron manufacturers for during April it is expected the price will be set for the last half of the year. There is inquiry for a large tonnage of iron and one consumer is said to be in the market for a quantity that will be felt. The quotations up to this time have been firm around $10.25@10.50 for No. 2 foundry, and the inquiries are along the line of getting the product at the first-named price. The manufacturers have not been willing to sell, expressing the belief that the price to be fixed for the last half of the year will be on stronger lines. The inventory to be taken this week will show a most satisfactory reduction of the stocks of iron in foundry and warrant yards in this section. The make can be materially increased with but short notice. The big consumption in the home territory is by the cast-iron pipe makers. These plants are running on full time.

Charcoal iron shows no change, either in price or in quantity of production, $22@22.50 being asked.

Chicago

Apr. 2—Sales of pig iron continue encouraging, but there is yet no advance in prices. The average founder, on whom this market chiefly depends, is buying more freely; a number of inquiries are out for large lots, but the disposition is to hold off from signing actual contracts and to watch closely the market. Orders now are for lots up to 1000 tons, with some inquiries over that amount, for second-quarter delivery mainly, and a few inquiries running into the last half.

For second-quarter delivery prices remain $10.50, Birmingham, on No. 2 Southern ($14.85, Chicago), and $14.50, furnace delivery, on Northern No. 2. On some sales this price probably is cut by at least 25c. The tone of the market, however, is stronger, and there is a disposition to ask the higher prices. The demand for local iron is lessening, in comparison with the demand for Southern, yet on small lots for quick delivery both Northern coke and Lake Superior charcoal have an advantage. The latter continues at $16.50 average price.

The market for iron and steel products is more active. The demand for railroad supplies has largely increased, rail orders being more numerous and for larger tonnage; track supplies are active. A stiffening of prices on supplies entering into railroad needs largely is being attempted, with the result of no noticeable diminution of sales.

Soft steel bars sell for 1.25@1.30c. and iron bars for 1.15@1.20c., with the demand active. For building material the tendency also is upward, but strike conditions in Chicago may lessen sharply the demand. Material up to 15 in. is now quoted at 1.30@1.35c. There is good business in sheets at slightly higher prices. Billets are steady at unchanged quotations. In wire goods there is activity due to the opening of spring trade. Plates are slightly higher, quotations running 1.30@1.35c., with the higher price asked on most business. General business conditions are stronger. There is a notable difficulty in obtaining coke supplies, which has advanced prices 25 or 50c., but this condition is looked upon as temporary and due to fear of labor troubles which have been quieted.

Cleveland

Apr. 1—Only a few additional sales of ore are reported. Some buyers seem to think that still lower prices may be male.

Pig Iron—Sales have been quite free, and some contracts for third quarter have been placed. Prices are a little firmer. Quotations, Cleveland delivery, are $15.15 for bessemer, $13.25@13.50 for No. 2 foundry, $12.50@12.75 for forge and $16.50 for Lake Superior charcoal.

Finished Material—New business is coming in well. Prices are firmer, especially on sheets, plates and structural.

Philadelphia

Apr. 3—The determined attitude of most pig-iron makers accounts for the rather light volume of business for the past week considering the amount of iron asked for by near-by buyers and consumers in New York and New England. Makers believe their terms will be acceeded to. Inquiries are more numerous. The drop in coke will not affect the present situation as supplies have been contracted for at high prices. There are pending inquiries for large quantities of iron for export and this fact helps to encourage makers. There is no certainty that the export demand will remain, as conditions in England may relieve European buyers from dependence on this side. Consumers of No. 2 X foundry have no occasion to purchase at present. Buyers of gray forge are purchasing in their usual hand-to-mouth way. Basic pig is strong but sales are limited. Several sales of Southern iron have been made within a week at full quotations. An adjustment of the anthracite strike will relieve the situation a good deal. The actual consumption of pig iron outside of gray forge is certainly increasing, but consumers generally are less anxious to anticipate requirements than they were two or three weeks ago. With the clearing up of the coal-strike situation, much will have been done to harmonize the views of buyers and makers. Quotations are $15@15.50 for No. 2 X; $14 for most grades of gray forge and $14.25 for basic, with $14.50 asked.

Steel Billets—Billets are strong at recent quotations and active mostly for early delivery and generally in small lots, though offers have been submitted for unusually large lots for late delivery at figures considerably below the latest mill quotations.

Bars—A general increase in mill orders for large lots is noted during the week. Steel bars are especially active. New car work has brought in quite a number of inquiries. Common iron is now under inquiry at several Eastern mills and the quantities wanted are large.

Pipes and Tubes—The pipe mills are crowded. Additional inquiries are reported today and inquiries for low-grade iron confirm the reports of the placing of new business for pipes. Tubes are also active, and two or three large concerns are about arranging for deliveries for three or four months ahead.

Plates—Plate mills are working almost to full capacity and with the placing of pending orders the plate output of this territory will represent full capacity.

Structural Material—Several held-up orders for shapes have been placed for material to be delivered within the next two months at an average of $1 or $2 per ton above recent quotations. The market is decidedly stronger, owing to the inauguration of the building season.

Scrap—After a long period of dullness, scrap is now moving briskly, especially heavy melting, railroad scrap, yard scrap and old steel axles. All kinds are in better demand and late buyers are paying higher prices than were asked a month ago.

Pittsburg

Apr. 2—At the Duquesne Club, Pittsburg, a little luncheon and meeting was held today, most of the important independent steel producers being present. The Steel Corporation was not represented. No official information is available as to what occurred, since the manufacturers refuse officially to admit that there was a meeting. The conference follows a similar one held recently in New York. The object, presumably, is to interchange information so that the manufacturers may show each other how well sold up they are and thus encourage the asking of higher prices.

The flow of specifications has been fairly good, and shows an improvement over conditions a fortnight ago. New buying is light. The generally quoted prices are 1.15c. on bars and 1.20c. on plates and shapes, these prices being adhered to by the Steel Corporation and by many of the independents. Locally the basis really prevails, but in several districts removed from Pittsburg there are lower figures, made by local producers. The Chicago district is endeavoring to maintain a 15c. arbitrary above Pittsburg, in place of the 18c. freight differential.

Production of steel in March made a new record for a month in the case of the Carnegie Steel Co. and the Republic Iron & Steel Co. The latter interest was assisted by its new openhearth plant, which made its first steel last June but did not operate in full until this month. The company's approximate output, of steel in the form in which it is shipped. was 52,000 tons of bessemer and 26,000 tons of openhearth.

Next Monday the Carnegie Steel Company will start making openhearth rails at the Ohio works, Youngstown, to the extent of 500 to 1000 tons daily, decreasing the output of sheet bars at the plant to that extent. It has been making openhearth rails at the Edgar Thomson plant, but as Edgar Thomson makes bessemer steel only the openhearth ingots must be brought from Homestead, and Homestead cannot spare sufficient to enable the company to make all the openhearth rails required. The total rail production of the Edgar Thomson plant last year was about 575,000 tons, and present prospects are that the output this year will be considerably larger. The light rail mill, No. 3, is operating at practically full capacity, making 10,000 to 12,000 tons monthly.

Pig Iron—The bessemer average for last month, compiled from actual sales,

was $14.0536, Valley, or $14.9536, Pittsburg, an increase of 5.36c. over February, when the average was $14, Valley. The basic average for March was $12.76, Valley, against $12.25 for February. The market has been rather quiet in the past week, but has lost none of its recently acquired strength. The furnaces are well sold up. Clinton furnace, Pittsburg, is banked on account of lack of coke and the report is that it neglected to purchase April coke at the proper time. Quotations are: Bessemer, $14.25; basic, $13; No. 2 foundry, $13.25; malleable, $13; forge, $12.75, Valley furnaces, 90c. higher delivered Pittsburg.

Ferromanganese—There has been a decided scarcity of ferromanganese for prompt shipment, and fancy prices have occasionally been paid for very small lots. Ordinarily prompt metal can be had at $41@42, while the forward market remains at $41, Baltimore, freight to Pittsburg being $1.95. Imports have been light for a couple of weeks, on account of the English coal strike.

Steel—The market is very irregular. The leading interest has been out of the market since January, but two or three of the independants have continued making low prices, although demand is excellent. The market is practically on a Youngstown basis, at $19.25@19.50 for billets and $19.50@20 for sheet bars, f.o.b. maker's mill, Youngstown, freight to Pittsburg district being $1. Rods are about $25, Pittsburg, and occasionally small lots are sold at this figure.

Sheets—The market has been showing a slight stiffening tendency, particularly on galvanized. The leading interest adheres to its minimum of 2.90c. on galvanized, and books a little business at this figure, being already practically sold up to July 1. On black sheets it is also firmer. The lowest prices are being made exclusively by a few independents. We quote: Black sheets, 28 gage, 1.80@1.85c.; galvanized, 2.80@2.90c.; blue annealed, 10 gage, 1.35@1.40c.; painted corrugated, $1.33@135; galvanized, $2.47@2.50 per square.

St. Louis

April 1—The pig-iron market is more active, and there are numerous inquiries, some for good quantities. Prices are firmly held at $10.50 Birmingham, or $14.25 St. Louis, for No. 2 Southern. Northern No. 2 foundry is in good demand at $14.25@14.50, St. Louis. There is a call for lower grade irons, but they are scarce.

The coke market is strong and supplies are rather scarce. Standard foundry coke commands $5.20@5.25 per ton, St. Louis. The coal mining suspension does not affect trade, as it is not expected to last long.

Iron Ore Trade

In the dock rebate cases in Cleveland the court has decided against some of the defendants, holding that the allowances made on dock charges were in the nature of a rebate. Moreover the Court approves the holding of the Interstate Commerce Commission that the high unloading charge unduly favors those companies which own or lease ore docks, the excessive charge giving them an advantage over competitors who have been obliged to pay the higher rates. It is insisted that the ownership or control should not be invested in companies shipping their own ore.

The sales reported last week seem to have fixed the prices of Lake Superior ore as follows: Old Range nonbessemers, base 55% iron and under 0.45 phosphorus, $3.75; Mesabi bessemers, $3.50; Old Range nonbessemers, base 51.5% iron, $3.05; Mesabi nonbessemers, $2.85; all f.o.b. Lake Erie ports. Some buyers, however, think that prices may go still lower.

At current prices Lake Old Range Bessemer would cost about 9.4c. per unit delivered in Eastern Pennsylvania, and Mesabi nonbessemer, same delivery, 8.35c. per unit.

Metal Markets

New York, Apr. 3—The copper market has continued in a highly excited condition. There have also been some active movements in lead. Spelter has been quieter, and there is little new in tin.

New York Metal Exchange—At the annual meeting, Apr. 1, the following officers were chosen: President, James E. Pope; vice-president, A. B. Hall; treasurer, James L. Crooke; board of managers, B. Hochschild, H. W. Hendricks, G. E. Behr, A. Baerwald, Edwin Groves, W. Parsons Todd, Erich Benjamin, and J. H. Lang. Arbitration committee: C. J. Marsh, J. Langeloth, E. J. Keane, P. R. Jennings, and Humphrey D. Bond.

In the table of prices given last week, the quotation for lead in St. Louis, on Mar. 23, 25, 26 and 27, was given at 4.17½@4.20c. through a clerical error. The correct St. Louis quotation was 4.20c. per lb. for each of those days.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal	Exports	Imports	Excess
Gold			
Feb. 1912..	$ 10,589,295	$ 2,937,274	Exp. $7,652,021
" 1911..	424,733	5,805,844	Imp. 5,381,111
Year 1912..	12,504,497	8,078,517	Exp. 4,425,980
" 1911..	1,348,409	15,346,674	Imp. 13,998,265
Silver			
Feb. 1912..	5,121,776	3,780,477	Exp. 1,341,329
" 1911..	4,453,171	3,897,946	Exp. 555,225
Year 1912..	11,149,681	8,138,486	Exp. 3,011,195
" 1911..	10,104,247	7,449,372	Exp. 2,654,875

Exports from the port of New York, week ended Mar. 30: Gold, $20,100; silver, $527,068, chiefly to London. Imports: Gold, $366,897; silver, $259,750, from the West Indies, Mexico and South America.

Gold—The price of gold on the open market in London remained at the usual level, 77s. 9d. per oz. for bars and 76s. 4d. per oz. for American coin. There was again some demand for India, but little for the Continent. In New York there is some talk of gold exports to Europe, but none have been actually made.

Iridium—Prices are steady at $64 per oz. for pure metal.

Platinum—The market is reported a little stronger in demand. Dealers quote $45.50 per oz. for refined platinum, and $48 per oz. for hard metal.

Our Russian correspondent writes, under date of Mar. 19, the market is dull and inactive and prices are largely nominal. It would be difficult to sell any large lot of metal at these rates just now. The quotations are 9.90 rubles per zolotnik for crude metal, 83 per cent. platinum, at Ekaterinburg, and 38,200 rubles per pood for the same grade at St. Petersburg; equivalent to $37.22 and $37.44 per oz., respectively. The future of the market depends on the foreign demand, as stocks are rather large.

Silver—The market has continued steady with a downward tendency until today, when, under an Indian speculative influence, it advanced ¼d. in London.

SILVER AND STERLING EXCHANGE

Mar.-Apr.	28	29	30	1	2	3
New York....	58¼	58⅛	58	58⅛	58⅛	58¾
London.....	26 11/16	26¾	26 11/16	26¾	26 11/16	27 1/16
Sterling Ex..	4.8695	4.8690	4.8690	4.8670	4.8685	4.8695

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Exports of silver from London to the East, Jan. 1 to Mar. 21, reported by Messrs. Pixley & Abell:

	1911	1912	Changes
India.....	£2,280,100	£1,545,300	D. £734,800
China.....	692,800	400,000	D. 292,800
Total.....	£2,972,900	£1,945,300	D. £1,027,600

A shipment of £551,500 to India, made in the week ended Mar. 21, was temporarily lost by the wreck of the steamer "Oceana," and it is not included above. It will probably be recovered.

India Council bills in London averaged 16.07d. per rupee for the week.

Foreign commerce of the United States, two months ended Feb. 29, as valued by the Bureau of Statistics, Department of Commerce and Labor:

Merchandise	1911	1912
Exports.....	$373,040,696	$401,322,701
Imports.....	252,255,974	277,838,498
Excess, exports.....	$120,784,722	$123,484,203
Add excess of exports, silver.....		3,011,195
Add excess of exports, gold.....		4,425,980
Total export balance.....		$130,921,378

Gold and silver movement in detail will be found in the table above.

Copper, Tin, Lead and Zinc

NEW YORK

Mar.-Apr.	Copper		Tin	Lead		Zinc	
	Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
	15½	15.32½			@4.17½	6.40	6.25
28	@15⅝	15.35	42¼	4.20	4.20	@6.55	@6.40
	15¼	15.35			4.17½	6.40	6.25
29	@15⅜	@15.40	42¾	4.20	@4.20	@6.55	@6.40
	15½	15.40			4.15	6.40	6.25
30	@15⅝	@15.45	42¾	4.20	@4.17½	@6.55	@6.40
	15¾	15.60			4.12½	6.40	6.25
1	@16	@15.80	43⅛	4.20	@4.17½	@6.55	@6.40
	15¾	15.60			4.12½	6.40	6.25
2	@16	@15.80	43	4.20	@4.17½	@6.55	@6.40
	15¾	15.60			4.12½	6.40	6.25
3	@16	@15.70	43⅛	4.20	@4.17½	@6.55	@6.40

The quotations for copper, lead, spelter and tin are for wholesale contracts with consumers, without distinction as to deliveries; and are representative, as nearly as possible, of the bulk of the transactions, reduced to basis of New York, cash, except where St. Louis is specified as the basing point. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. and that for casting copper usually about 0.125 to 0.2c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market for good ordinary brands, both desilverized and non-desilverized; specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium.

LONDON

Mar.-Apr.	Copper			Tin		Lead, Spanish	Zinc, Ordinaries
	Spot	3 Mos	Best Sel'td	Spot	3 Mos		
28	68 3/16	69 1/16	72¾	193	189¼	16⅛	25⅛
29	69⅛	70⅜	74	195	191	16⅛	25¼
30	.....	.....	.....	.....	.....	.....	.....
1	70⅝	71½	75	196¾	192¼	16⅛	25¼
2	70⅝	71½	75	196½	192¾	16 3/16	25¼
3	69¾	70⅝	75	197	192¾	16 3/16	25⅜

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c; £12 = 2.61c.; £23 = 5c.; £60 = 13.04c. ± £1 = ± 0.21¾c.

Copper—The market crept upward on March 29-30 under the influence of relatively small business. On April 1 a crazy demand set in from Hamburg and London, causing a jump of ¼c. and more in the price. American agencies made sales of electrolytic copper at prices ranging from 15.80 to 16c., delivered in Europe, higher prices being asked from the speculative interests than for copper known to be destined directly to consumers, but premiums were willingly paid. At the same time prices as high as 15⅞, delivered, usual terms, were realized from domestic manufacturers. The market on this day was very erratic, sales being made at a wide range of price. The aggregate of the business was some millions of pounds, chiefly to Europe. On Tuesday the market became quieter but held the advance, though with indications of softening in the latter part of the day after the receipt of the second cable from London showing a decline in the standard market. The opening cable on Apr. 3, showing a decline of 32s. 6d., half of which was regained at the closing, created an uncertainty in this market and a disposition to await further events. As was the case in the previous week the demand for Lake copper was moderate this week and the sales reported by several agencies were of but small volume. The market closes quiet at 15¾@16c. for Lake copper and 15.60 @15.70 for electrolytic in cakes, ingots and wirebars. Casting copper is quoted nominally at 15¼@15½c. as the average for the week.

The London standard market, which on Mar. 28, was £68 3s. 9d. for spot and £69 1s. 3d. for three months, advanced about £1 on Mar. 29, and a further £1 on Apr. 1. On Apr. 3, under realization of speculative holdings, the market declined to £69 for spot and £69 18s. 9d. for three months, but it closes at £69 15s. for spot, and £70 12s. 6d. for three months.

Copper sheets have been advanced and are now 21@22c. base for large lots. Full extras are charged and higher prices for small quantities. Copper wire has again been advanced to 17c. base, carload lots at mill.

Copper exports from New York for the week were 6286 long tons. Our special correspondent gives the exports from Baltimore at 2061 tons.

There has recently been a steep advance in the freight rates to the European ports, which has had an important effect upon shipments of copper. The rate on copper from New York to Liverpool has gone from 7s. 6d. to 15s. (16.2c. per 100 lb.); the rate from New York to Hamburg has gone from 10c. to 16c. per lb., and the rates to other ports about the same way.

Visible stocks of copper in Europe Mar. 31 are reported as follows: Great Britain, 35,730; France, 6420; Rotterdam, 3300; Hamburg, 7600; afloat from Chile, 2330; afloat from Australia, 5700; total, 61,080 long tons, a decrease of 950 tons from the Mar. 15 report.

Imports of copper in Germany, two months ended Feb. 29, are reported by L. Vogelstein & Co. at 33,787 tons; exports were 1717 tons, leaving the apparent consumption of foreign copper 32,074 tons, against 28,138 tons last year. Of the imports this year, 29,293 tons were from the United States.

Brass Prices—The American Brass Co. on Apr. 1 advanced brass prices as follows: Sheets, high brass, 16¾c. net per lb.; low brass, 18¼c. Wire, high brass, 16½c.; low brass, 18¼c. Rods, high brass, 16½c.; low brass, 19c. Tubing, brazed, 21½c.; open-seam, 20⅛c. Brass angles and channels, 20½c. Scrap allowances, 11¼c. net per lb. for high brass and 12¼c. for low brass scrap.

Tin—With the exception of Mar. 28, on which day the London market took a sudden slump, which was attributed to the liquidation of a speculator's holdings, the metal ruled firm throughout the week. There was also more interest shown than heretofore, which was evidenced by the increased transactions.

The market here was dull. Spot tin is again scarce and commanding a slight premium. The market closes very firm at £197 for spot, and £192 15s. for three months, and about 43⅛c. for April tin here.

Visible stocks of tin on Mar. 31 are reported as follows: London, 7694; Holland, 1944; United States, excluding Pacific ports, 6056; total, 15,694 long tons, an increase of 698 tons in March.

Exports of tin from the Straits in March are reported at 2410 long tons.

Lead—The conditions in this market that we have recently reported led to the concentration of speculative business in St. Louis and brought the price at that point to a parity with New York. This led to the transaction of some business for delivery at interior points at the St. Louis price, plus freight, as, for example, 4.32½c., Buffalo, a higher price than those realized at either St. Louis or New York. Since Mar. 21 the market at St. Louis has eased off under offerings both from second hand and first hand, there having evidently grown a fuller appreciation of the probability that recent operations of the leading interests were designed for the purpose of marketing lead rather than for any peculiar and merely temporary purpose. Consequently, there has developed more of a willingness by independent producers to enter the market again and an indication of cutting of prices, sales having been made at as low as 4.12½c., St. Louis. We quote at the close 4.20, New York, and 4.12½@4.17½, St. Louis.

Lead at London continues firm, and Spanish lead is quoted at £16 3s. 9d., and English lead 2s. 6d. higher.

Spelter—There has been almost complete stagnation, nobody having apparently wanted to buy. We quote the market nominally at 6.25@6.40c., St. Louis, and 6.40@6.55c., New York, although somewhat higher prices are asked for prompt deliveries and lower terms are offered for the later dates.

The London market for good ordinaries is quoted at £25 7s. 6d. and £25 12s. 6d. for specials.

Zinc dust is quoted at 7⅛c. per lb. New York.

Base price of zinc-sheets is $8.65 per 100 lb., f.o.b. La Salle-Peru, Ill., less 8% discount.

Silesian Market—Paul Speier writes from Breslau, Germany, that the coal strikes in England and Germany have adversely affected the market. Syndicate price for ordinary brands of spelter for April is 54.65 marks per 100 kg.—5.90c. per lb.—f.o.b. works in Silesia. Special brands are 1 mark higher. Zinc sheets are 65.75@68.75 marks per 100 kg.—average 7.26c. per lb. Zinc dust in 10-ton lots is 51.75 marks per 100 kg.—5.51c. per lb.—delivered at Stettin.

Imports and Exports of Metals

Exports and imports of metals in the United States, two months ended Feb. 29, are reported as follows, in the measures usual in the trade:

Metals	Exports	Imports	Excess
Copper, long tons	65,785	33,506	Exp. 32,279
Copper, 1911	61,077	23,990	Exp. 27,087
Tin, long tons	57	8,458	Imp. 8,401
Tin, 1911	58	8,063	Imp. 8,005
Lead, short tons	10,074	19,471	Imp. 9,397
Lead, 1911	11,471	17,453	Imp. 5,982
Zinc, short tons	3,861	2,196	Exp. 1,665
Zinc, 1911	815	477	Exp. 338
Nickel, lb.	3,961,172	5,484,354	Imp. 1,523,182
Nickel, 1911	4,570,605	4,627,157	Imp. 56,552
Antimony, lb.	.....	1,789,986	Imp. 1,789,986
Antimony, 1911	139,524	1,205,249	Imp. 1,065,725
Platinum, oz.	.....	13,987	Imp. 13,987
Platinum, 1911	47	11,504	Imp. 11,457
Aluminum, lb.	8,425	3,231,455	Imp. 3,223,030
Aluminum, 1911	.....	.....	.....
Ores, etc.			
Zinc in ore, lb.	7,162,587	5,491,794	Exp. 1,670,793
In ore, 1911	2,211,938	7,793,970	Imp. 5,582,032
Zinc oxide, lb.	4,452,007	.....	Exp. 4,452,007
Zinc oxide, '11	4,117,695	.....	Exp. 4,117,695
Zinc dross, lb.	299,424	.....	Exp. 299,424
Zinc dross, '11	985,490	.....	Exp. 985,490
Chrome ore, l.t.	.....	9,251	Imp. 9,252
Chrome ore, '11	.....	7,979	Imp. 7,979

Copper, lead, nickel and antimony include the metal contents of ores, matte, bullion, etc. Quantity of antimony ore is not reported. Quantity of zinc ore imported in 1912 was 8125 tons; exported, 4587. Imports of aluminum were not reported previous to July 1, 1911. The metal exports given above include re-exports of foreign materials.

Other Metals

Aluminum—Business has been good; demand is increasing and prices are again firmer. Quotations are 20@20½c. per lb. for No. 1 ingots, New York. The foreign market is also reported to be firm with a tendency to advance.

Antimony—Business is fair and the market is steady. The quotation for Cookson's is 8c. per lb., and for Hallett's and U. S. 7¾c.; while 6⅞@7c. is named for Hungarian, Chinese and other outside brands.

Quicksilver—The demand is still fair but prices are rather unsettled and there is some range. New York quotations are $42@44 per flask of 75 lb., with the usual advances for small quantities. San Francisco is $42.50 for domestic orders and $40 for export. The London price is £8 12s. 6d. per flask, with £8 7s. 6d.@£8 10s. quoted from second hands.

Cadmium—The latest quotation received is 700 marks per 100 kg., f.o.b. works in Silesia, Germany. This is equal to 75.6c. per lb., at works.

Bismuth—The syndicate which controls the European production quotes 7s. 6d.—equal to $1.80—per lb. in London. In New York a quotation of $1.72 per lb. is made for metal produced from American ores.

Magnesium—The price of pure metal is $1.50 per lb. for 100-lb. lots, f.o.b. New York.

Nickel—Large lots, contract business, 40@45c. per lb. Retail spot from 50c. for 500-lb. lots up to 55c. for 200-lb. lots. The price of electrolytic is 5c. higher.

Zinc and Lead Ore Markets

Platteville, Wis., Mar. 30—The base price paid this week for 60 per cent. zinc ore was $50@51 per ton. The base price paid for 80 per cent. lead ore was $52@53 per ton.

SHIPMENTS, WEEK ENDED MAR. 30

Camps	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Mineral Point	967,510	.....	.....
Benton	829,100	.....	344,900
Galena	766,200	.....	.....
Shullsburg	618,700	.....	.....
Highland	537,700	.....	.....
Platteville	406,950	.....	.....
Hazel Green	382,000	.....	.....
Harker	211,420	.....	.....
Cuba City	142,000	84,560	84,340
Livingston	80,000	.....	.....
Linden	.....	87,560	59,190
Total	4,941,580	172,260	488,430
Year to date	50,087,170	1,381,610	4,710,890

Shipped during week to separating plants, 2,191,800 lb. zinc ore.

Joplin, Mo., Mar. 30—The high price of zinc sulphide ore is $55, the base price per ton of 60% zinc, $48@52. Zinc silicate sold for $25@29 per ton of 40% zinc. The average price, all grades of zinc, is $48.50. Purchases were made at the week-end, for next week's delivery, on a base of $53 per ton. Lead sold as high as $57.50 per ton, with competition active between the local smelters and the St. Louis Smelting & Refining Co. The average price, all grades of lead, was $55.94 per ton. Heavy rain during the week has precipitated a fight against water encroachment. It is six years since so wet a season was known.

SHIPMENTS, WEEK ENDED MAR. 30

	Blende	Calamine	Lead Ore	Value
Webb City-Carterville	4,695,760	.....	984,260	$144,948
Joplin	2,189,210	.....	300,590	65,335
Duenweg	759,060	325,510	56,590	24,682
Alba-Neck	941,050	.....	.....	23,867
Galena	689,260	.....	117,690	19,835
Miami	311,940	.....	250,330	13,680
Jackson	475,910	.....	16,570	12,355
Carl Junction	289,610	.....	.....	7,965
Carthage	286,850	.....	.....	7,171
Spurgeon	79,730	171,890	26,850	5,160
Cave Springs	190,160	.....	.....	4,750
Granby	59,090	174,220	9,450	3,970
Oronogo	154,090	.....	.....	3,685
Aurora	74,960	130,000	.....	3,670
Wentworth	101,000	.....	.....	2,424
Stott City	60,580	.....	.....	1,515
Lawton	57,190	.....	.....	1,425
Quapaw	58,190	.....	.....	1,280
Sarcoxie	.....	64,000	.....	896
Totals	11,473,640	865,620	1,762,330	$348,613
3 months	127,917,010	7,369,810	20,765,560	$3,653,348

Blende val., the week, $286,442; 3 months, $2,974,096
Calamine, the week, 12,858; 3 months, 104,185
Lead value, the week, 49,313; 3 months, 575,067

MONTHLY AVERAGE PRICES

Month	Zinc Ore				Lead Ore	
	Base Price		All Ores		All Ores	
	1911	1912	1911	1912	1911	1912
January	$41.85	$44.90	$40.55	$43.54	$55.68	$58.92
February	40.21	45.75	39.16	43.31	54.46	52.39
March	39.85	51.56	38.45	49.25	54.57	54.64
April	38.88	.....	37.47	.....	56.37	.....
May	38.25	.....	36.79	.....	55.21	.....
June	40.50	.....	38.18	.....	56.49	.....
July	40.75	.....	38.36	.....	58.81	.....
August	42.50	.....	41.28	.....	60.74	.....
September	42.63	.....	41.29	.....	59.33	.....
October	42.38	.....	40.89	.....	54.72	.....
November	45.40	.....	43.25	.....	57.19	.....
December	44.13	.....	40.76	.....	62.03	.....
Year	$41.45	.....	$39.90	.....	$56.76	.....

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Other Ore Markets

Zinc Ores—For Rocky Mountain blende of good quality, especially as to iron and lead contents, the current price is for the zinc contents, less eight units at the St. Louis price for spelter; with a deduction of $16 to $18 per 2000 lb. of ore; sellers to deliver ore at smeltery. Penalties may be charged for detrimental impurities. Blende is readily obtainable at Joplin on the basis of 87 per cent. of the zinc content at St. Louis quotation, less $16 for treatment, and less penalties for iron and lime.

Chemicals

New York, Apr. 3—The general market is rather quiet and shows little change.

Imports and Exports—Imports and exports of chemicals and raw material in the United States, two months ended Feb. 29:

	Imports	Exports	Excess
Copper sulph. lb.	.....	4,130,329	E. 4,130,329
Copper sul., '11	.....	3,066,338	E. 3,066,338
Bleach, lb.	16,812,467	.....	I. 16,812,467
Bleach, 1911	18,901,600	.....	I. 18,901,600
Potash salts, lb.	141,819,348	78,008	I. 141,741,340
Potash salts, '11	166,398,195	104,032	I. 166,294,163
Soda salts, lb.	2,018,415	95,747	I. 1,922,668
Soda salts, 1911	7,802,112	125,643	I. 7,676,469
Acetate lime, lb.	.....	8,923,891	E. 8,923,891
Acetate, 1911	.....	10,397,575	E. 10,397,575
Nit. of soda, tons	80,062	1,277	I. 78,785
Nitrate, 1911	139,521	1,330	I. 138,191
Phosphates, tons	.....	134,906	E. 134,906
Phosphates, '11	.....	126,471	E. 126,471
Sulphur, tons	3,484	2,188	I. 1,296
Sulphur, 1911	6,079	407	I. 5,672
Pyrites, tons	126,516	.....	I. 126,516
Pyrites, 1911	141,552	.....	I. 141,552
Magnesite, lb.	16,708,344	149,440	I. 16,558,904
Magnesite, 1911	36,427,253	443,940	I. 35,983,313
Sul. ammonia, lb.	33,314,839	.....	I. 33,314,839
Sul. am'nia, '11	67,996,826	.....	I. 67,996,826
Arsenic, lb.	768,666	.....	I. 768,866
Arsenic, 1911	848,302	.....	I. 848,302

Exports include reëxports of foreign material. Estimating sulphur contents of pyrites the total quantity of sulphur imported this year was 123,291 tons.

Copper Sulphate—Business is good. Prices have again been advanced and are now $5.25 per 100 lb. for carload lots and $5.50 per 100 lb. for smaller parcels.

Arsenic—Spot supplies are extremely scarce and sales of white arsenic have

been made as high as $4 per 100 lb., while $3.75 per 100 lb. is quoted for futures.

Nitrate of Soda—Current demand is good and spot nitrate is firm at 2.35c. per lb. Futures are a shade higher, 2.35c. per lb. being asked to June 30, and 2.30c. for later dates.

Chemicals and Minerals

CURRENT WHOLESALE PRICES

Ammonium sulphate.....cwt.	3.35
Arsenic, white.....lb.	0.03¾@0.04
Barytes, ground.....sh. ton	12.50@14.00
" floated.....sh. ton	16.00@17.00
Calcium acetate, gray.....cwt.	2.25@2.30
carbide, ton lots f.o.b. Niagara Falls..sh. ton	70.00
Carbons, good drill quality, carat	50.00@75.00
Cement, Port., Am. 400-lb. bbl.	1.33
Chrome brick, f.o.b., Pittsburg M.	175.00
ore, 50%, ex-ship, N. Y., lg. ton	14.00@16.00
Copperas, bulk.....cwt.	0.55
bbl.....cwt.	0.60@0.85
Copper sulphate.....cwt.	5.25@5.50
Fluorspar, lump, f.o.b. Pittsburg, ton	8.00@9.00
Magnesite, crude, 95%....lg. ton	7.50@8.50
calcined, powdered...	26.00@35.00
brick, dom., f.o.b. Pittsburg.....M.	160@180
Paints, litharge, Am. powd...lb.	0.05½@0.06
red lead, American...lb.	0.06½@0.07
white lead, Am., dry..lb.	0.05½@0.05¾
zinc white, Am., dry...lb.	0.05⅛@0.06¼
Phosphates, acid:	
*Fla., hard rock 77%.....	5.75@6.00
land pebble 68%.....	3.70@3.80
†Tenn., 78@80%.....	5.00@5.50
75%.....	4.75@5.00
68@72%.....	4.25@4.50
‡So. Car. land rock 60%.....	3.50@3.75
Potassium cyanide, 98@99%..lb.	0.18@0.20
Pyrite:	
Domestic, non-arsenical, furnace size, f.o.b. R.R. per unit	0.12@0.12½
Domestic, non-arsenical, fines, per unit, f.o.b. mines.....	0.11½@0.12
Imported, non-arsenical, furnace size, ex-ship, per unit..	0.13½
Imported, arsenical, furnace size, ex-ship, per unit.....	0.12¾@0.13
Imported, fines, arsenical, ex-ship.....	0.11@0.12
Imported, fines non-arsenical, ex-ship, per unit.....	0.12½

Pyrite prices are per unit of sulphur. A deduction of 25c. per ton is made when ore is delivered in large lumps.

Sodium cyanide, 120 to 130% KCN.....lb.	0.18@0.20
nitrate 95% spot....cwt.	2.35
95% future..cwt.	2.35
Sulphur, Louisiana prime, N. Y., lg. ton	22.00@22.50
roll.....cwt.	1.85@2.15
flour.....cwt.	2.00@2.40
flowers, sublimed...cwt.	2.20@2.60
pow. com., bags....cwt.	1.50
Sicilian, crude brimstone.....lg. ton	22.50
Zinc chloride, granular.....lb.	0.04¼@0.04½

*F.o.b. Florida or Georgia ports. †F.o.b. Mt. Pleasant. ‡On vessel Ashley River, S. C.

NOTE—These quotations are for ordinary wholesale lots in New York unless otherwise specified, and are generally subject to the usual trade discounts. In the cases of some of the important minerals, such as phosphate rock, pyrites and sulphur, in which there are well established markets, the quotations are substantially representative. But in the cases of some of the minor mineral products, the quotations represent what dealers ask of consumers and not what producers can realize in selling their output on private contract.

Petroleum

Oil production in California in February is reported at 6,893,482 bbl.; deliveries, 6,301,985 bbl.; stocks on Feb. 29 were 42,236,635 bbl. The number of new wells completed in February was 65, and 8 wells were abandoned.

MINING STOCKS

New York, Apr. 3—Mar. 28 the market opened somewhat irregular, but toward the close prices generally advanced. Amalgamated Copper closed at 80½. On the Curb there was a good business, well distributed, but a little irregular. Some coppers advanced and others declined, changes being only fractional. Cobalts were a little weak, but other mining stocks firm. There was much excitement in the Standard Oil stocks; Standard of Kentucky advanced from 425 to over 950, on small sales.

Mar. 29 the Exchange was again irregular, but with a tendency to firmer prices in general. Dealings on the Curb in mining stocks were less active. The Standard Oil stocks showed some sensational declines from the very high points of the previous day.

Mar. 30 the Exchange remained strong and prices were, for the most part, well supported. The Curb was again irregular, so far as mining stocks were concerned; but fluctuations were small.

April 1 the Exchange was active and strong. Amalgamated Copper again advanced and Steel common sold up. On the Curb there was good trading in mining stocks, the coppers being especially strong.

Apr. 2 the Exchange fell off a little under the pressure of realizing sales, but recovered toward the close. Mining stocks on the Curb were active, the coppers being especially strong. Apr. 3 both Exchange and Curb were active, with prices generally well maintained.

At auction in New York, Feb. 28, a block of 50,000 shares Santo Domingo Mining Company, $1 par, brought $30 for the lot.

Boston, Apr. 2—The copper-share market has gained great momentum by the continued strength of the metal and is almost laboring under an old-time bull movement. This state of affairs is entirely welcome and brokers and holders of copper shares alike are happy. Trading has been on a large scale and while special stocks have shown material advances certain specialties have recorded almost phenomenal gains. Calumet & Hecla, for instance, is up $35 in the week's time, touching an even $500 per share. This compares with a low record price of $360 last year.

Lake Copper has been the most conspicuous feature outside of Calumet, having risen over $10 per share to $48.75. Another instance is a $3 advance in North Butte to $34.50 ex-dividend. A factor in the advance of this stock is the raising of the dividend rate from 30c. to 40c. quarterly.

Mayflower made a new high record at $13.50, an advance of over $3, while Old Colony, its running mate, rose $1.75 to $8.50. Calumet & Arizona has shown a clean slate with a $5 advance to $75. Amalgamated Copper, with its high price of the year, has been a strong incentive for trading on the long side.

On the Curb Ahmeek has risen to a record price of $300 per share, an ad-

COPPER PRODUCTION REPORTS

Copper contents of blister copper, in pounds

Company	Jan.	Feb.	March
Alaska shipments.	3,701,010	.....	.....
Anaconda.....	26,350,000	27,450,000	.....
Arizona, Ltd.....	3,200,000	3,020,000	.....
Copper Queen.....	6,748,264	6,046,860	7,197,121
Calumet & Ariz....	4,544,000	4,452,004	4,652,000
Detroit.....	1,941,970	2,068,370	.....
East Butte.....	1,520,000	.....	.....
Mammoth.....	1,665,319	1,722,954	.....
Mason Valley.....	600,000	1,100,000	.....
Nevada Con.....	6,309,228	.....	.....
Old Dominion.....	2,044,000	2,039,000	.....
Ray.....	2,475,945	2,140,000	.....
Shannon.....	1,550,000	1,300,000	1,388,000
South Utah.....	189,678	283,838	.....
United Verde*.....	2,000,000	2,250,000	.....
Utah Copper Co....	8,156,612	.....	.....
Lake Superior*....	17,500,000	19,000,000	.....
Non-rep. mines*...	8,400,000	8,000,000	.....
Total production.	98,896,026	.....	.....
Imports, bars, etc..	31,790,590	18,976,513	.....
Total blister.....	130,686,616	.....	.....
Imp. in ore & matte	8,340,740	10,432,438	.....
Total.....	139,027,356	.....	.....
Miami.....	2,235,647	2,475,996	.....
Brit. Col. Cos.:			
British Col. Copper	538,190	860,003	.....
Granby.....	1,607,558	1,773,496	.....
Mexican Cos.:			
Boleo.....	2,315,040	2,204,720	.....
Cananea	3,552,000	.....	.....
Moctezuma	2,732,867	2,687,712	2,446,731
Other Foreign:			
Cape Cop., S. Africa	784,000	786,440	.....
Kyshtim, Russia...	.....	.....	.....
Spassky, Russia....	795,200	649,600	.....
Famatina, Argen..	172,480	.....	.....
Tilt Cove, Newf'd..	153,257	109,059	.....
Exports from:			
Chile.....	8,064,000	6,720,000	.....
Australia.....	7,056,000	7,164,000	.....
Arrivals in Europe†	13,144,320	10,868,680	.....

Figures are reports received from companies, unless otherwise stated. Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.

*Estimated. †Does not include the United States, Australia or Chile.

STATISTICS OF COPPER.

Month	United States Product'n	Deliveries, Domestic	Deliveries for Export
III, 1911.....	130,532,080	66,080,789	59,081,127
IV.....	118,085,223	52,407,650	62,129,599
V.....	126,962,544	64,543,963	61,978,557
VI.....	124,554,312	61,655,561	71,460,519
VII.....	112,167,934	56,982,582	74,880,658
VIII.....	125,493,667	59,935,364	69,855,660
IX.....	115,588,950	57,311,584	50,824,011
X.....	118,255,442	64,068,307	60,084,349
XI.....	111,876,601	68,039,776	67,049,279
XII.....	122,896,697	65,988,474	79,238,716
Year, 1911...	1,431,938,338	709,611,605	754,902,233
I, 1912.....	119,337,753	62,343,901	80,167,904
II.....	116,035,809	56,228,368	63,148,096
III.....	.....	.....	.....

	VISIBLE STOCKS		
	United States	Europe	Total
IV, 1911.....	162,007,934	223,014,400	385,022,434
V.....	165,555,908	212,284,800	377,840,708
VI.....	165,995,932	202,540,800	368,536,732
VII.....	157,434,164	195,932,800	353,366,964
VIII.....	137,738,858	191,891,840	329,630,698
IX.....	133,441,501	191,228,800	324,670,301
X.....	140,894,856	191,945,600	332,840,456
XI.....	134,997,642	176,825,600	311,823,242
XII.....	111,785,188	164,281,600	276,066,788
I, 1912.....	89,454,695	158,323,200	247,777,895
II.....	66,280,643	154,851,200	221,131,843
III.....	62,939,988	141,142,400	204,082,388
IV	.....	136,819,200	.....

Figures are in pounds of fine copper. U. S. production includes all copper refined in this country, both from domestic and imported material. Visible stocks are those reported on the first day of each month, as brought over from the preceding month.

vance of $25 during the week. Southwestern Miami, on the declaration of an initial dividend, is up almost $2 to $9.43¾. Curb stocks are following the trend of the regular market with increased animation.

Assessments

Company	Delinq	Sale	Amt
Alameda, Idaho	Apr. 1	.....	$0.005
Algomah, Mich	Jan. 22	.....	1.00
Belcher, Nev	Apr. 8	Apr. 30	0.10
Best & Belcher, Nev	Mar. 19	Apr. 8	0.05
Black Jack, Utah	Feb. 6	.....	0.01
Boston Ely, Nev	Jan. 18	.....	0.50
Cedar-Talisman, Utah	Apr. 20	.....	0.005
Con. Virginia, Nev	Apr. 24	May 15	0.20
Crown Point, Nev	Mar. 28	Apr. 19	0.05
Ely Con., Nev	.....	.....	0.05
Gould & Curry, Nev	Apr. 19	May 10	0.05
Hale & Norcross, Nev	Apr. 12	May 3	0.05
Hancock, Mich	Mar. 28	.....	1.00
Kentuck, Nev	Feb. 29	Mar. 19	0.05
Lehi Tintic, Utah	Feb. 29	.....	0.01½
Leonora, Utah	Apr. 15	Apr. 30	0.0125
Lower Mammoth, Utah	Mar. 16	.....	0.01
New York Bonanza, Utah	Mar. 14	Apr. 4	0.02
O. K. Extension, Utah	Apr. 26	May 15	0.002½
Ojibway, Mich	Jan. 10	.....	1.005
Overman, Nev	Apr. 9	Apr. 30	0.05
Raven, Mont	Feb. 1	.....	0.10
Savage, Nev	Feb. 14	Mar. 7	0.10
Sierra Nevada, Nev	Apr. 3	Apr. 24	0.10
Southwestern Miami, Ariz.	Jan. 15	.....	1.00
Tintic Central, Utah	Mar. 9	Mar. 27	0.005
Union Con., Nev	Feb. 20	Mar. 12	0.15
Wabash, Utah	Mar. 19	Apr. 10	0.10

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1910	1911	1912	1910	1911	1912
January	52.375	53.795	56.260	24.154	24.865	25.887
February	51.534	52.222	59.043	23.794	24.081	27.190
March	51.454	52.745	58.375	23.690	24.324	26.875
April	53.221	53.325	.....	24.483	24.595	.....
May	53.870	53.308	.....	24.797	24.583	.....
June	53.462	53.043	.....	24.651	24.486	.....
July	54.150	52.630	.....	25.034	24.286	.....
August	52.912	52.171	.....	24.428	24.082	.....
September	53.295	52.440	.....	24.567	24.209	.....
October	55.490	53.340	.....	25.596	24.594	.....
November	55.635	55.719	.....	25.680	25.649	.....
December	54.428	54.905	.....	25.160	25.349	.....
Year	53.486	53.304	.....	24.670	24.592	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

	New York				London, Standard	
	Electrolytic		Lake			
	1911	1912	1911	1912	1911	1912
January	12.295	14.094	12.680	14.337	55.600	62.760
February	12.256	14.084	12.611	14.329	54.974	62.893
March	12.139	14.698	12.447	14.868	54.704	65.884
April	12.019	.....	12.275	.....	54.034	.....
May	11.989	.....	12.214	.....	54.313	.....
June	12.385	.....	12.611	.....	56.365	.....
July	12.463	.....	12.720	.....	56.673	.....
August	12.405	.....	12.634	.....	56.266	.....
September	12.201	.....	12.508	.....	55.253	.....
October	12.189	.....	12.370	.....	55.170	.....
November	12.616	.....	12.769	.....	57.253	.....
December	13.552	.....	13.768	.....	62.068	.....
Year	12.376	.....	12.634	.....	55.973	.....

New York, cents per pound, London, pounds sterling per long ton of standard copper.

TIN AT NEW YORK

Month	1911	1912	Month	1911	1912
January	41.255	42.529	July	42.400	.....
February	41.614	42.962	August	43.319	.....
March	40.157	42.577	September	39.755	.....
April	42.185	.....	October	41.185	.....
May	43.115	.....	November	43.125	.....
June	44.606	.....	December	44.655	.....
			Av. Year	42.281	.....

Prices are in cents per pound.

LEAD

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	4.483	4.435	4.334	4.327	13.009	15.619
February	4.440	4.026	4.266	3.946	13.043	15.738
March	4.394	4.073	4.238	4.046	13.122	15.997
April	4.412	.....	4.262	.....	12.889	.....
May	4.373	.....	4.223	.....	12.984	.....
June	4.435	.....	4.292	.....	13.260	.....
July	4.499	.....	4.397	.....	13.530	.....
August	4.500	.....	4.406	.....	14.260	.....
September	4.485	.....	4.356	.....	14.744	.....
October	4.265	.....	4.139	.....	15.332	.....
November	4.298	.....	4.181	.....	15.821	.....
December	4.450	.....	4.332	.....	15.648	.....
Year	4.420	.....	4.286	.....	13.970	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1911	1912	1911	1912	1911	1912
January	5.452	6.442	5.302	6.292	23.887	26.642
February	5.518	6.499	5.368	6.349	23.276	26.661
March	5.563	6.626	5.413	6.476	23.016	26.048
April	5.399	.....	5.249	.....	23.743	.....
May	5.348	.....	5.198	.....	24.375	.....
June	5.520	.....	5.370	.....	24.612	.....
July	5.695	.....	5.545	.....	25.006	.....
August	5.953	.....	5.803	.....	26.801	.....
September	5.869	.....	5.719	.....	27.750	.....
October	6.102	.....	5.951	.....	27.256	.....
November	6.380	.....	6.223	.....	26.795	.....
December	6.301	.....	6.151	.....	26.849	.....
Year	5.758	.....	5.608	.....	25.281	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON AT PITTSBURG

	Bessemer		Basic		No. 2 Foundry	
	1911	1912	1911	1912	1911	1912
January	$15.90	$15.12	$14.40	$13.32	$14.75	$14.00
February	15.90	15.03	14.50	13.28	14.81	14.01
March	15.90	14.95	14.65	13.66	14.96	14.10
April	15.90	.....	14.65	.....	15.00	.....
May	15.90	.....	14.30	.....	14.72	.....
June	15.90	.....	14.06	.....	14.56	.....
July	15.90	.....	14.03	.....	14.53	.....
August	15.90	.....	14.00	.....	14.47	.....
September	15.90	.....	13.57	.....	14.40	.....
October	15.43	.....	13.44	.....	14.34	.....
November	14.92	.....	13.30	.....	14.25	.....
December	15.15	.....	13.10	.....	13.90	.....
Year	$15.72	.....	$13.94	.....	$14.49	.....

STOCK QUOTATIONS

COLO. SPRINGS Apr. 2

Name of Comp.	Bid.
Acacia	.05½
Cripple Cr'k Con.	.02
C. K. & N.	.19½
Doctor Jack Pot.	.06
Elkton Con	.63
El Paso	.76½
Findlay	.04
Gold Dollar	.14
Gold Sovereign	.02½
Isabella	.12
Jack Pot	.06
Jennie Sample	.05½
Lexington	.01
Moon Anchor	‡ 01
Old Gold	03
Mary McKinney	.59
Pharmacist	.02½
Portland	.90
Vindicator	.73½
Work	.01

SALT LAKE Apr. 2

Name of Comp.	Bid.
Beck Tunnel	.15
Black Jack	.15
Carisa	‡.15
Cedar Talisman	.02
Colorado Mining	.30
Columbus Con	.20
Daly-Judge	‡5.50
Grand Central	.66
Iron Blossom	1.30
Little Bell	.39
Lower Mammoth	.04½
Mason Valley	13.00
May Day	.15
Nevada Hills	2.40
New York	‡.05
Prince Con	1.15
Silver King Coal'n	1.67½
Sioux Con	.04
Uncle Sam	.23
Yankee	‡.15

TORONTO Apr. 2

Name of Comp.	Bid	Name of Comp.	Bid
Coniagas	7.50	Hollinger	11.90
Hudson Bay	‡70.00	Imperial	.06½
Temiskaming	.41	Pearl Lake	.19
Wettlaufer-Lor.	.68	Porcu. Gold	.42
Apex	.04	Porcu. Tisdale	.03
Central	5.00	Preston E. D.	.10
Crown Chartered	‡.28	West. Dome	.40
Dobie	.45	Standard	.13
Dome Exten	.57	Rea	.55
Foley O'Brien	.30	Swastika	.25

SAN FRANCISCO Apr. 2

Name of Comp.	Clg.	Name of Comp.	Bid
COMSTOCK STOCKS		MISC. NEV. & CAL.	
Alta	.10	Belmont	10.12½
Belcher	.79	Jim Butler	.71
Best & Belcher	.21	MacNamara	.25
Caledonia	3.90	Midway	.38
Challenge Con	.32	Mont.-Tonopah	2.90
Chollar	.14	North Star	.31
Confidence	1.00	West End Con,	2.32½
Con. Virginia	.77	Atlanta	.26
Crown Point	.80	Booth	.10
Gould & Curry	.08	C.O.D. Con	.11
Hale & Norcross	.34	Comb. Frac	.19
Mexican	3 45	Jumbo Extension	.44
Occidental	.65	Pitts.-Silver Peak	1.40
Ophir	1.45	Silver Pick	.10
Overman	2 05	St. Ives	.35
Potosi	.13	Tramp Con	.01
Savage	.29	Argonaut	2.00
Sierra Nevada	.37	Bunker Hill	‡5.50
Union Con	.99	Cent. Eureka	‡.22
Yellow Jacket	1.00	So. Eureka	‡5.00

N. Y. EXCH. Apr. 2

Name of Comp.	Clg.
Amalgamated	82⅝
Am. Agri. Chem	61¾
Am.Sm.&Ref.,com	87
Am.Sm.& Ref.,pf.	107⅛
Am.Sm. Sec., pf. B	87¾
Anaconda	44⅛
Batopilas Min	1⅞
BethlehemSteelpf	63
Chino	29⅜
FederalM. &S., pf.	43
Goldfield Con	4⅛
GreatNor.,ore.,ctf.	42⅜
Homestake	91
Miami Copper	26⅛
Nat'nalLead,com.	57
National Lead, pf.	109
Nev. Consol	20¼
Pittsburg Coal, pf.	82⅜
Ray Con	20⅛
Republic I&S,com.	21⅜
Republic I & S, pf.	73
SlossSheffi'd,com.	46¼
Sloss Sheffield, pf.	100
Tennessee Copper	41¼
Utah Copper	63¼
U. S. Steel, com	68¾
U. S. Steel, pf.	112⅜
Va. Car. Chem.	53½

N. Y. CURB Apr. 2

Name of Comp.	Clg.
Barnes King	.20
Beaver Con	.43
Braden Copper	5¾
B. C. Copper	57⅛
Buffalo Mines	‡1¾
Butte & Vipond	‡.53
Caledonia	‡.50
Con. Ariz. Sm.	1/16
Davis-Daly	1⅜
Diam'field-Daisy	15
Ely Con	3/16
Florence	.78
Giroux	5⅞
Gold Hill Con	1/16
Greene Cananea	9⅜
Greenwater	.08
Guggen. Exp	221
Inspiration Con	20⅛
Internat. S. & R.	‡128
LaGrange Placer	2⅞
Kerr Lake	2
La Rose	3
McKinley-Dar-Sa	14
Min. Co. of A. new	3¾
Nev. Utah M. & S.	1/16
Nipissing Mines	8⅛
Ohio Copper	2
Pacific Sm. & M	1/16
Precious Metals	‡1⅝
Ray Central	2
Red Warrior	‡1⅛
South Utah M. & S.	1
Standard Oil (Old)	842
Stand'd Oil of N.J.	362
Stand'd Oil Subs.	500
Stewart	1⅜
Tonopah	7⅛
Tonopah Ex	1⅞
Tri-Bullion	¾
Tularosa	1⅜
United Cop., pfd.	15
Yukon Gold	3

LONDON Apr. 3

Name of Com.	Clg.
Camp Bird	£1 10s 9d
Dolores	1 10 0
El Oro	0 17 0
Esperanza	1 13 1½
Mexico Mines	6 15 0
Oroville	0 4 9
Stratton'sInd.	0 3 1½
Tomboy	1 1 3

BOSTON EXCH. Apr. 2

Name of Comp.	Clg.
Adventure	5⅛
Algomah	7
Allouez	47
Am. Zinc	27½
Ariz. Com., ctfs.	6½
Bonanza	.45
Boston & Corbin	7⅜
Butte & Balak	5⅛
Calumet & Ariz	74½
Calumet & Hecla	490
Centennial	23
Con. Mercur	.04
Copper Range	63¾
Daly West	6¾
East Butte	15⅛
Franklin	15⅝
Granby	42⅞
Hancock	33¾
Hedley Gold	18
Helvetia	1⅜
Indiana	17
Island Cr'k, com	43
Island Cr'k, pfd.	86
Isle Royale	28⅛
Keweenaw	2
Lake	46⅞
La Salle	6⅛
Mass	8¾
Michigan	3½
Mohawk	64
New Arcadian	4½
New Idria Quick	6⅞
North Butte	33¾
North Lake	7⅜
Ojibway	5¾
Old Dominion	54⅛
Osceola	117
Quincy	85¼
Shannon	15⅜
Shattuck-Ariz	22½
Superior	34⅛
Superior & Bost.	3⅜
Tamarack	31
Trinity	6½
Tuolumne	4
Union Mines	2¼
U. S. Smelting	39½
U. S. Smelt'g, pf.	48½
Utah Apex	3
Utah Con	20
Victoria	4⅞
Winona	7⅝
Wolverine	114
Wyandot	2½

BOSTON CURB Apr. 2

Name of Comp.	Last
Ahmeek	285
Bingham Mines	3½
Boston Ely	2½
Boswyocolo	.08
Butte Central	7½
Cactus	.16
Calaveras	3.00
Chief Cons	2½
Corbin	2⅛
Cortez	1
Crown Reserve	3½
First Nat. Cop	2½
Majestic	.76
Mazatan	.75
Moneta Porc	.15
Nevada-Douglas	4
New Baltic	3½
Oneco	2½
Raven Copper	.45
Rhode IslandCoal	.15
San Antonio	3
S. W. Miami	9½
South Lake	8
Trethewey	.65
United Verde Ext.	.53
Vulture	‡5.00

‡Last quotation.